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OF

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By John Flint South, Esq., F.L.S., F.R.C.S.,
Surgeon to St. Thomas's Hospital,
and
Frederick Le Gros Clark, Esq., F.R.C.S.,
Surgeon to St. Thomas's Hospital.

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CONTENTS

OF THE

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ANATOMY.

The Anatomy of the Bones and Muscles. By JOHN FLINT SOUTH, Esq., F. L. S., Surgeon to St. Thomas's Hospital.

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ANATOMY.

Anatomy. The term "Anatomy," in its most correct and extensive sense, implies the examination of the structure and economy of the several parts and organs not only of animal but also of vegetable bodies. In its more restricted and conventional employment, however, it is applied specially to that branch of the Science which treats of the fabric of the human body, and the organs of which it consists. The description of the tissues composing the several organs has been already given in the Essay on Zoology; it therefore remains to consider the form and arrangement of the organs themselves, which is the province of Descriptive Anatomy.

SECTION I.

OF THE BONES AND THEIR APPENDAGES,—*viz.*, LIGAMENTS, CARTILAGES, AND SYNOVIAL MEMBRANES.

The natural junction of the Bones by ligaments, cartilages, and synovial membranes, forms the Skeleton (Anat. Pl. I. and II.), which serves three purposes; *first*, as a frame-work upon which the soft parts are at once extended and supported; *second*, as furnishing cavities for the entire or partial lodgment and protection of the more important organs; and, *third*, as providing a series of levers for the motions of the whole or any part or parts of the body. The first office is performed by the whole Skeleton; the second by the Head, Spine, Chest, and Basin; and the third by the Limbs. The division of the Human Skeleton into the three principal parts,—trunk, head, and limbs,—corresponds generally with that of the other Vertebrate Classes, but modified in reference to its special condition and economy, which is mainly influenced by the erect posture, by station on the hinder, or rather lower limbs, thereby allowing free use of the fore or upper limbs without interference with the carriage or locomotion of the body, and by the great development of the cerebral portion of the brain, which produces correspondent size and form in the skull.

1.—OF THE SPINE.

Columna Vertebralis, Lat.; *der Ruckgrat*, Germ.; *la Colonne Vertébrale*, Fr. (Anat. Pl. III., fig. I. to XVII.)

The Spine or Backbone consists of twenty-six Vertebres, piled one above another, and forming an irregular pillar, often called the Spinal or Vertebral Column (figs. XII. XIII. XIV.). Each Vertebre (fig. I. to X.) (*Vertebra*, Lat.; *Wirbel*, Germ.; *Vertèbre*, Fr.) has an irregularly-shaped short cylindrical body (a.), behind which is the spinal hole (b.) produced by the arch-like junction of the seven processes with the back of the body. Of these processes the two transverse (c. c.), which stand out from each side of the arch, and the spinous (d.) from its back, serve the purpose of levers; whilst the other four, viz., two upper articular processes (e. e.) facing backwards, and two lower (f. f.) looking forwards, link the vertebral pieces together. The spinal canal, which runs from end to end of the vertebral column, results from the piling upon each other of the rings forming the spinal holes, and lodges the spinal marrow; the apertures on each side of it for the passage of the spinal nerves are produced by the conjunction of the notches at the roots of the articular processes, with corresponding notches of the Vertebres above and below each bone.

The Spine is anatomically divided into regions, commonly known as the neck, back, loins, and rump; to the Cervical or neck (figs. XII. XIII. XIV. a.) belong seven Vertebres; to the Dorsal or back (b.), twelve; to the Lumbar or loins (c.), five; and to the rump (d. e.), two, of which the upper piece (d.) is the true rump-bone, and the lower (e.) the rudiment of the tail-bones of other Vertebrate Animals. These Vertebres in their several regions perform peculiar offices; hence their form varies, and their specific characters easily distinguish them; but the nearer each region approaches the other, the more nearly does one resemble the other, and therefore the special form is best developed in the central pieces of each division.

Of the Neck (*Cervix*, Lat.; *der Hals*, Germ.; *le Cou*, Fr.) (Figs. IV. V. VI. VII).

The principal use of this region being mobility, the Vertebres of which it consists are formed specially with that object; accordingly their bodies (a.) are of small size, and their lever-like transverse (c. c.) and spinous (d.) processes large. The upper (g.) and under surfaces of their bodies are so formed as to allow greater extent of motion than in any other part of the Spine, the upper being hollowed from side to side and the under from before to behind, so that when the bones are connected by their ligaments, a chain-like motion is performed, and thereby great mobility provided without loss of strength or connexion. The articular processes face obliquely the upper (e. e.) upwards and backwards, the lower (f. f.) downwards and forwards; hence the term "oblique," sometimes applied generally but improperly to the articular processes of all Vertebres, is to these specially appropriate. They are also more or less hollowed, and permit sliding on each other in the inclination of the head forwards and backwards, or to either side. These motions are confined to the six lower Vertebres of this division; and although between any two they are not extensive, yet is the combined motion of all very considerable. The transverse (c. c.) and spinous (d.) processes are each

bifid, *i. e.*, terminating in a fork-like form, and hence they admit of very minute degrees of motion by the operation of single portions of the muscles attached to them, whilst the horizontal direction, which they generally affect, allows considerable motion backwards, forwards, or aside, before the processes strike upon each other. In each transverse process is a hole (i.), and through the upper six Vertebres the vertebral artery on each side ascends to the brain; but in the seventh, the holes give passage to a pair of veins from the venous trunks of the Spinal Marrow, which portion of the Nervous System being of considerable bulk whilst passing through the Neck, the spinal holes forming the canal are of correspondent size, the largest among all the Vertebres, and of triangular shape.

In addition to the variation of the typical form of the Neck Vertebres as they approach the back, the uppermost two exhibit some very remarkable characters in consequence of the partial revolution of the head upon the Spine. This motion does not occur, as might at first be supposed, between the head and the first Cervical Vertebre, but between the first and second pieces of the Neck, the head being so intimately connected with the former as to allow but very slight motion. Strictly speaking, therefore, with respect to motion, the first Neck Vertebre should be considered as an appendage to the head, and the second as the commencement of the Spinal Column, for which reason its description will precede that of the former.

The Second Neck Vertebre, or *Pivot* (fig. IV.), is so called from a stout pivot or tooth-like process (j.) springing up from the top of its body. Its transverse processes are small, but the spinous very bulky, as might be expected from the strong muscles attached to and acting upon it: its superior articular processes are very extensive. The pivot-like process is received into

The First Neck Vertebre, or *Atlas* (figs. V. and VI.), so called from supporting the head. It is little more than a mere ring with a pair of deep sockets on its upper outer edges, into which the condyles of the skull are received, and another pair of broad flat ones below, joining it with the corresponding processes of the Second Vertebre; whilst the fore part, which in the other Vertebres forms the body, is hollowed out into an arc (g.), the radius of which faces backwards, is only naturally perfected by a strong ligament, and thereby separated from the spinal canal. Into this hole the pivot of the Second Vertebre is received, and upon it the Atlas to a certain extent revolves. As the rotatory motion of the head is thus really performed by the Atlas, the transverse processes (c. c.) are especially developed, and jut out far beyond those of any other of the Neck Vertebres. Flexion and extension being scarcely, if at all, performed either between the Second and First Vertebre, or between the latter and the head, the spinous process of the First Vertebre is a mere stud.

The Seventh Neck Vertebre also differs from the others by its nearer approximation to those of the back in its transverse and spinous processes, being single, and the latter being hooked much downwards, so that it has little rotatory motion.

Of the Back (*Dorsum*, Lat.; *der Rücken*, Germ.; *le Dos*, Fr.) (Figs. I. II. III.)

The Vertebres composing the Dorsal Region of the Spine present a marked difference of form when compared with that of the Cervical, in which, as already noticed, the mechanism was specially with reference to motion, whilst in these the arrangement of the several parts is in relation to firmness, and to afford fixed points upon which the motions of the ribs may be performed. The former object, firmness, is effected by the great hooking down of the spinous processes (d.), which, overlapping each other like tiles, prevent any rotatory motion, and admit only of a little lateral inclination, with flexion and extension, but in a slight degree. To the latter intent the transverse processes (c. c.), which are horizontal and directed backwards so as to increase the capacity of the chest from behind to before, are single, and have articular surfaces (k.) for the angles of the ribs, the heads of which are further connected with the Spine by articular surfaces or hollows on the sides of the bodies of the Vertebres formed by the junction of two, each of the Vertebres having on either side at the upper and lower edge of its body a half articular surface (l. m.), which, being joined to that of the superjacent and subjacent Vertebre, forms a socket for the head of a rib. The articular processes (e. e. f. f.) are vertical and nearly plane, and thereby present an additional obstacle to other than flexion, extension, and lateral inclination.

Variations are also observed from their general form in these Vertebres. Whilst the eight following the first have each a half socket for the ribs on the upper and lower edges of the bodies, so that a pair of ribs is supported by two Vertebres, the first has a pair of whole ones for the first pair of ribs, besides the pair of half ones for the second; the tenth has only a pair of half sockets for the tenth pair of ribs, whilst the eleventh and twelfth have each a pair of whole sockets supporting the corresponding pair of ribs, which are therefore connected only with one instead of two Vertebres. The eleventh and twelfth dorsal Vertebres are also further distinguished by the small size of their transverse processes, which resemble those of the loins, leading gradually to the greater and more varied motions of the latter division of the Spine. The first Back Vertebre is characterized by having at its upper part a pair o whole articular surfaces for the first pair of ribs, besides the pair of half ones belonging to the second ribs. It is almost immovable, forming at the same time a base upon which the motions of the Neck are performed, and a point from whence the motions of the ribs are primarily derived.

The Loins (*Lumbus*, Lat.; *die Lende*, Germ.; *les Lombes*, Fr.) (Figs. VIII. IX.)

In the Loins the movement of the several Vertebres upon each other is very extensive, and more varied than in the back. The greater part of the motions of the trunk upon itself are here performed, consisting of flexion, extension, and swaying to either side, or a combination of all these movements, producing in the upper part of the trunk a motion corresponding with that of the upper free moving end of a rod, of which the lower moves only upon its own axis in a cup. The lateral inclination is allowed by the small size of the transverse, and facilitated by the form of the articular processes, the lower of which (f. f.), each resembling the vertical section of a solid cylinder, are received into corresponding but concave half cylinders, which form the upper articular surfaces (e. e.) of the subjacent Vertebre, a kind

of junction specially adapted for rotatory motion. The spinous processes (d.) are short, and nearly horizontal, and a considerable quantity of soft substance being interposed between the bodies of the Vertebres, a very great degree of flexion and extension is admitted. The spinous hole (b.) in this division again becomes large and triangular, in which respect it resembles the Cervical: in that it was large on account of the great size of the spinal nervous cord; in this it is capacious to permit the branching of the same cord immediately prior to its termination.

The last Lumbar Vertebre is distinguished from the others by its immobility, the front edge of the lower surface of its body bending over the top of the body of the rump-bone, and its spinous process hooking down upon the spinal arch of that bone.

Thus far the description has had special reference to the motions of the several pieces of the Spine upon each other, but there is another point of view in which the Vertebres are to be considered, viz., as forming a pyramid of support, or rather a rod upon which the neck, chest, and belly are suspended. As might be expected, the base of this pyramid or rod, speaking in general terms, is the broader, and the apex the narrower. The pillar of support is specially formed by the bodies of the Vertebres, the base of which is the last Lumbar, and the tip the Second Cervical. Circumstances, however, exist which prevent the regular diminution of the column from below upwards without diminishing its strength. The opportunity of increasing its capacity, as may be needed, being allowed to the belly by its soft muscular walls on the sides and front, which are capable of extension, the bodies of the Lumbar Vertebres are very large, and much expanded laterally; still, however, they diminish from below upwards, so that the upper are much smaller than the lower Vertebres. In the Dorsal portion, however, the case is altered: this, as will be hereafter shown, forms part of the Chest, a cavity surrounded by bone, and from this cause incapable of extension beyond a certain point; the Vertebres are therefore required to be as small as possible to prevent their trenching on the cavity, regard being still had to the strength of the Spine, and accordingly their bodies are narrow laterally in comparison with the Lumbar, but in proportion to this dimension are more extended from before to behind. This lateral narrowing continues as high up as the fifth, from whence they again become wider and wider, but less extended from before to behind up to the first. This diminution of width, however, is of no material consequence, being compensated by the connexion of the ribs, which strengthens the Dorsal part of the Spine, although the vertebral bodies are diminished in size. Whilst, on the contrary, the upper members of the Dorsal Spine have the extent of their bodies increased, not only to strengthen them as fixed or nearly fixed points for the junction of the upper ribs, but also to afford a base for the support of the Cervical Vertebres, which are broad below, but narrow as they ascend to support the head, and to afford room for the muscles by which they are moved.

Of the Rump (*Uropygium*, Lat.; *das Kreuz*, Germ.; *le Croupe*, Fr.)

The remaining portion of the Spinal Column consists of two bones, the Rump-bone and the Tail-bone. By the former more especially the Lower Limbs are connected with the Spine through the intervention of a pair of bones, which, with the two forming the Rump, produce a bony cavity hereafter to be described.

The Rump-bone (*Os Sacrum*, Lat.; *die Kreuz-bein*, Germ.; *le Sacrum*, Fr.). (Fig. x.)

Placed immediately beneath the last Lumbar Vertebre is a large bone of a flattened pyramidal or wedge-like form, with its broad base (g.) above and its narrow tip (f.) below; it is concave from above downwards, and from side to side in front, and convex from above downwards behind. In the young subject it consists of five pieces, which, having the general form of vertebres, are called *false vertebres*, but in the adult state are united into a single bone. Their original separation is, however, still indicated by four slight and horizontal ridges, traversing the middle or body of the bone. On either side of the body are seen four apertures, by which nerves are transmitted, and corresponding to the holes formed by the approximation of the roots of the transverse processes in the true Vertebres. The transverse processes in this bone, however, being consolidated, a large articular or joint surface (c.) is produced on each of its sides, by which it is connected with the Hip-bones. The hinder surface has along its middle a sequence of little bony studs (d. d. d. d.) corresponding to the spinous processes of the Vertebres. The top of the body, called its base (g.), has a large plane oval surface, to connect it with the body of the last Lumbar Vertebre, and a pair of hollow articular processes (e. e.) to receive the corresponding processes of that Vertebre. The lower end of the body has a small oval articular surface for the Tail-bone. The spinal canal is continued down between the body and spinous processes, but varies in different individuals, being more or less open at the lower part from the deficiency of its hinder walls, and sometimes leaving even the whole canal open throughout like a narrow gutter. The Vertebral pieces are consolidated, and form thus a single bone, to afford a stronger connexion to the Hip-bones than if they remained separate. This subject must be again adverted to in speaking of the Basin or Pelvis, when also the applicability of its peculiar disposition and form will be better understood.

The Tail-bone (*Os Coccygis, seu Coccyx*, Lat.; *die Steiss-bein*, Germ.; *le Coccis*, Fr.) (Fig. xi.)

The Tail, though not appearing externally to the common covering of the body, as in most of the higher animals, exists in the human subject in the form of four or five small pieces, resembling transverse sections of the Rump-bone with its spinal arch cut off, and therefore no canal for the spinal cord is found. These always in the young, and most generally in the adult, exist as distinct portions, but occasionally are found united into a single bone, resembling a diminutive Rump-bone, the original divisions being indicated by three or four transversely indented lines. The upper piece (a. b.) has a pair of small elevated processes (a. a.) which connect its hind part more firmly to the Rump-bone, but neither of the other pieces (d. e. f.) have any process. The object effected by the permanent division of this bone, as is usually the case, will be noted in treating of the Basin or Pelvis.

Of the Vertebral Joints (Figs. xv. xvi. xvii.).

The connexion of the Vertebral pieces being with reference both to strength and mobility, is effected, inde-

pendently of the muscles, which also tie them together, in three different ways: *first*, by a ligamento-cartilaginous substance between their bodies; *secondly*, by true ligamentous bands, some passing from one Vertebre to another, and others connected with all save one; and *thirdly*, by true joints, in which exist true joint or articular surfaces, covered with cartilage, and included in an investing capsular ligament, lined with synovial membrane, which also overspreads the articular cartilages.

1. All the Vertebres, below the first Cervical, have their bodies connected together by a fibro-cartilaginous structure, which from its position is called the Intervertebral Substance (a.) (*fibro-cartilago-intervertebralis*, Lat.; *der zwischenwirbelknorpel*, Germ.; *les fibro-cartilages*, Fr.). Each consists of a series of concentric bands, toughest and most resisting at the margin of the vertebral bodies, but looser and more yielding as they approach the centre, till at last they resolve into an almost half fluid mass. How this acts, is best illustrated by reference to the vertebral junction in Fishes. In these animals, as shown in the Essay on Zoology, p. 295, the body of each Vertebre is hollowed out into a fore and hind conical cavity, the points of which are opposed to each other in the centre of the body, but do not communicate; the margin of the base of each cone is connected by a ligamentous ring with the preceding and subsequent Vertebre, and thus a hollow double cone occurs between every two of these bones, in which is contained a watery fluid. This fluid being incompressible, and the bony cones no less so, it follows that whenever one cone is moved on the other, the ligamentous ring, which is alone yielding, is subjected to the pressure which the fluid makes in the opposite direction to that in which the bones are approximated; but the central part of the fluid remains nearly or entirely unchanged, whilst the rings of the cones may be rolling round upon each other, and therefore forms an incompressible though movable and infrangible centre, so long as the marginal ring remains unbroken. Now in the human subject exactly the same function is performed by the Intervertebral Substance; its marginal rings, from their elasticity, may be compressed or expanded, but the central and more fluid part retains its incompressibility; and accordingly, if the muscles or any other cause operate to incline the Vertebres to one side, whilst the central soft substance is displaced in that, yet it displaces the marginal rings on the opposite direction, and thus still remains as a pivot upon which one Vertebre moves or rather sways upon another. So soon, however, as the displacing cause ceases to operate, the natural elasticity of the marginal rings especially, and the disposition of the central soft part to resume its proper place, both tend to restore the natural vertical position of the Spinal Column.

In like manner, as the bodies of all the Vertebres, except the first, are connected by this fibro-cartilaginous structure, so are their arches by another peculiar kind of substance, which is called the Yellow Substance (g.) (*ligamenta subflava*, Lat.; *die gelbliche bänder*, Germ.; *les ligamens jaunes*, Fr.). Each piece consists of thick, short vertical fibres, of a yellow colour, and elastic, which pass from the lower edge of the arch of one to the upper edge of the arch of another Vertebre; their length depends upon the distance between the vertebral arches, they are therefore longer in the loins than many other parts of the Spine. Their use, however, throughout is the same; they strengthen the connexion of the Vertebres, assist in restoring the vertical position of the spine when it has been disturbed, and have material influence in preserving the erect posture of the trunk without violent muscular exertion.

2. The next kind of junction which the Spine presents is the mere colligation or tying together of its several pieces. To this purpose the two just-mentioned substances also serve, but there are other and true ligaments which perform this duty alone; such are, The Anterior Common Ligament (b.) (*ligamentum commune anterius*), which commences at the basilar process of the Occipital bone, passes down, connected with the front of the body of every Vertebre, and is finally spread out upon the front of the Rump-bone: it varies in breadth from half an inch to an inch, according to the size of the Vertebres, being narrowest in the neck and widest in the loins; but it is thickest where the Spine is weakest, viz., upon the upper Back Vertebres, and thus compensates for the seemingly deficient strength of that part. The Posterior Common Ligament (*ligamentum commune posterius*) commences by a fan-like expansion from the upper surface of the basilar process within the skull, passes through the great occipital hole, is attached to the tip of the pivot of the second Cervical Vertebre (which portion is sometimes described as distinct, and called the Perpendicular Ligament), then descends, expanding over the hind part of the bodies of all the Vertebres, and is ultimately lost on the back of the body of the Rump-bone. The margins of the bodies of all the Vertebres, except the first and second Cervical, are further connected by means of ligamentous fibres called Crucial Ligaments (*ligamenta cruciformia*), from their direction, which decussate upon the Intervertebral Substance, and are connected both with it and with the bodies of the Vertebres. Narrow bands of ligament pass also from one transverse process to another, and from one spinous process to another, which are called Intertransverse and Interspinous Ligaments (c.) (*ligamenta intertransversa*, and *interspinosa*).

3. The remaining junction of the Vertebres is by their joint or articular processes, which are alone, anatomically speaking, *true joints*. The opposing surfaces of these processes are covered each with a thin layer of cartilage, and invested in a close ligamentous collar or capsular ligament (*ligamenta capsularia*), lined with synovial membrane. These capsules, in all the vertebral joints below the second cervical, allow flexion and extension, lateral inclination, and a complication of all three; but between the second and first Vertebres the motion, from the nearly horizontal position of the articular surfaces, is only rotatory, and between the first Vertebre and the skull only slight flexion and extension, owing to the great depth of the sockets in the former for the latter bone.

The Ligaments already described are common to all the Vertebral pieces, but the motions between the second and first Neck Vertebres and the latter and the skull being different, inasmuch as they are performed by true joints, and the principal motion being horizontal, and performed between the two just named Vertebres, some ligaments are there found necessary for the performance and restriction of these motions, which are not required in the more confined movements of the other Vertebral pieces. They are, therefore, proper Ligaments of these Vertebres and of the occipital bone,

and consist of three, besides that part of the Common Anterior Ligament, by some anatomists called the Perpendicular, and by them considered as one of the proper Ligaments.

It will be recollected that the pivot of the Second Neck Vertebre rises up into a hollow in front of the vertebral canal of the first Vertebre, produced by the scooping out of the back of the body of that Vertebre; in this the pivot is confined by means of a Transverse Ligament (*ligamentum Atlantis transversum*, Lat.), which, passing behind the root of that process, from one side of the Atlas to the other, completes a ring placed round the pivot, carrying with it the skull. The horizontal motion, however, thus performed, does not, when measured from point to point, exceed one-third of the circumference of a circle, being restricted by a pair of ligaments, viz. the Lateral (*ligamenta lateralia*, Lat.), which, originating from the sides of the pivot, ascend obliquely outwards, and are attached to the upper and inner edge of the occipital hole. The more extended motion by which the head describes a half circle upon the shoulders is effected by the movement of the Neck Vertebres upon each other.

General Observations relating to the Spine.

As to Form.—The Spine in different positions exhibits very different appearances. In front it assumes, from the Rump-bone upwards to the Atlas, the form of a tall pyramid, the base of which is the last Lumbar, and the apex the second Cervical Vertebre. Closer observation, however, will show that it really consists of three pyramids, the lower two connected by their tips and the upper two by their bases. From the last Lumbar to the fourth or fifth Dorsal, the bodies of the Vertebres gradually diminish, and here is the top of the first pyramid; from this point, forming the top of the second pyramid, the bodies gradually widen up to the last Cervical, which forms its base, and the base also of the third pyramid, the top of which occurs at the second Cervical Vertebre. The diminution of the width of the bodies of the Dorsal Vertebres increases the capacity of the Chest.

A side view of the Spine shows it, not as might be at first expected, upright, but of an undulating form from before to behind; consequently, the perpendicular mesial line, which passing through the basilar process of the occipital bone drops between the feet, only touches it between the fourth and fifth Neck Vertebres, and between the second and fourth Loin Vertebres. At these points two forward curves are produced, and above and below them the Spine recedes, the greatest recession being opposite the middle of the Rump-bone, which is two inches behind the mesial line, whilst at the fourth Back Vertebre it is an inch behind, and opposite the Atlas half an inch. The use of these recessions is to increase the capacity of the cavities opposite which they are, and also to assist in preserving the equipoise of the trunk, as will be hereafter noticed. In this view of the Spine may also be observed the relative height of the intervertebral substance throughout the whole of the Vertebral column below the Neck: this is greatest in the Loins, where is the greatest quantity of motion, both flexion, extension, and swaying to either side being performed in consequence of the small size of the transverse and the distance of the spinous processes from each other. The direction of the transverse processes is also worthy of notice: in the Neck and Loins they stand directly outwards, but in the Back incline considerably backwards, to increase the capacity of the Chest. In front of them a series of holes are seen, one between every two Vertebres, by which the nerves pass out from the Vertebral Canal. Behind the transverse processes, on each side, is a hollow corresponding to the curves of the Spine, and bounded by the spinous processes, which in the Neck and Loins pass directly backwards, are quite distinct from each other, and therefore allow free rotation of one Vertebre upon another, so far as they are concerned; but in the Back they lap over one another like a series of tiles, and prevent any other motion than slight flexion and extension.

The hind view, as to form, exhibits little more than is seen in front; the spinous processes occupy the mesial line, and the principal points to be noted are the forked forms of those in the Neck, the sharp upper edges of those in the Back, which terminate almost in points, and the depth of those in the Loins. In the Back, the arches of the Vertebres overlap so completely that they resemble scales, and no space exists between them, in which respect they differ widely from the lumbar arches, which are short, nearly vertical, and far apart from each other, so that the Vertebral Canal is open between them; the same also occurs in the Cervical portion of the Spine, but the Arches are less widely apart. Below the last Loin Vertebre the back of the Rump-bone is seen, with its imperfect spinous processes, and sometimes the arch is entirely deficient; on either side a row of small holes for the transmission of nerves. The Tail-bone is seen below it, curving forwards.

The last circumstance to be adverted to in the Spine, with reference to its form as a whole, is the Spinal or Vertebral Canal (*canalis vertebralis, seu spinalis*, Lat.; *der rückenmarks-kanal*, Germ.; *le canal vertébral*, Fr.). This is produced by the sequence of the spinal holes, and the yellow substance which connects the vertebral arches. Its course follows the several curves of the Spine. Its form is triangular, with the base towards the bodies, and the point towards the spinous processes of the Vertebres. It varies considerably in size, as might be expected from the varying size of the Spinal Cord of Nervous Matter, which it contains and protects; in the Neck, its greatest transverse diameter measures three-quarters of an inch, in the Back about seven-twelfths, in the Loins rather less, and in the Rump-bone much less; its extent from before to behind is in the Neck half an inch, and in the Back and Loins seven-twelfths; whilst its transverse diameter in the Neck is three-quarters of an inch, and in the other regions only a little more than half an inch. On either side, and behind the bodies of the Vertebres, are pairs of holes through which the nerves pass from the Canal; of these there are seven to the Neck, twelve to the Back, five to the Loins, and five to the Rump-bone.

As to Mechanism.—The mechanical structure of the Spine must be considered under five points of view: *first*, in reference to self-support; *secondly*, as supporting the Trunk and Head; *thirdly*, as protecting the Spinal Cord; *fourthly*, in reference to the motions it performs upon itself; and *fifthly*, as being the fixed point either to be moved by the locomotive organs, or from which the prehensile organs commence the performance of their functions.

a. *Self-support.*—It may seem almost paradoxical to state that the undulating form of the Spine is the best

suited for its support; but when shall hereafter be pointed out the complicated offices it has to perform, this will prove to be the case, and will present one of the many beautiful examples of the Infinite Wisdom with which the human body has been constructed. The subject, however, cannot be fully carried out till we have further examined and are more fully acquainted with other mechanical parts of the body, not only as relating to the cavities of which the trunk consists, but also with reference to the muscular forces which are constantly operating upon the Spine. All that can be here adverted to is, that the bodies of all the Vertebres are kept a certain distance apart by the intervertebral substance, everywhere highly elastic, but most so at the margin; whilst towards the centre it assumes a half fluid form, and, being contained in an elastic ring, forms a hydrostatic pivot, which, when compressed by the weight of the head and upper limbs, bulges out the elastic ring to a certain extent, but is restricted by the crucial ligaments which pass from the margin of the body of one to that of another Vertebre; and if the general vertical position of the Spine be disturbed by any agent, this half fluid mass, not diminished in quantity, but still occupying the same quantum of space, though not the same actual space as if compressed on one side, thrusts out the elastic ring in the opposite direction, to find room for itself. *Procession* and *recession*, or the falling forwards or backwards of the Spine, are prevented; the former immediately by the posterior common ligament which connects the hind part of the bodies of all the Vertebres, and mediately by the ligamentous junction of the spinous processes, which act like the rod of a steelyard, to the extremity of which a very slight weight being appended, a very heavy weight upon the short limb is easily counterbalanced; the latter, recession, directly by the anterior common ligament which connects the front of the bodies of all the Vertebres, and indirectly in the Neck by the weight of the head, the principal part of which is before the Vertebral Column, in the Back by the overlapping of its spinous processes, and in the Loins by the overhanging forwards of the Back upon the receding Lumbar Vertebres. Now, though the Spine, as far as hitherto noticed, is, by the means already referred to, preserved in its vertical position as regards its several pieces, yet taken as a whole it is always disposed to fall forwards, although its base, as will be hereafter seen, is placed far behind the lower limbs which support the trunk: this arises from the weight of the greater part of the head, and that of the chest and belly being before it. This tendency is necessary to facilitate progression; it is not, however, so great as might at first be imagined, and is counterbalanced by the large size and disposition of the gluteal muscles peculiar to man. *Lateral inclination, or swaying from side to side*, is prevented in the Neck and Loins by muscles, which in those parts brace the Spine upright, as a ship's masts are braced up by the shrouds; and in the Back, by the connexion of the ribs to the bodies and transverse processes of the Vertebres, which almost entirely preclude lateral motion.

b. *As supporting the Trunk and Head.*—The Vertebres being connected and braced up, as already stated, there is no difficulty in understanding that, when steadied by muscles, the Spine is fully competent to sustain any weight, as the chest and belly, which may be appended to it in front, or placed, like the head, upon its top.

c. *As protecting the Spinal Cord.*—The firm connexion of the numerous pieces of which the Spine is composed, allowing but very little motion of any kind between any two pieces (excepting between the Atlas and Axis), although when acting together very considerable movements are performed, indicates the great care with which Nature has provided against injury to the Spinal Cord, commensurate with the important functions which this portion of the Nervous System has to perform in the Animal Œconomy. It might be supposed that the Spine would have been stronger had it consisted of but one long bony cylinder; had it been so, however, the necessary as well as graceful motions of the Trunk could not have been performed, and it would actually have been less strong and less protection to the Spinal Cord than as at present composed; for if a cylinder of such length as the Spine is, and with walls only of such thickness as could be made by the quantity of bone forming the Spine, received a blow, it would readily break, and in breaking tear through the Spinal Cord. Whereas, on the contrary, the bony cylinder being divided into so many pieces as it is, would yield to a certain extent, and distribute throughout the whole chain any blow which should be received upon it, and so diminish the liability to fracture and the danger of injuring the Spinal Cord. Also as regards the ligamentous connexions, these do not diminish the strength of the Spine but rather increase it, for they not only deaden the shock of any blow received by interposing a soft substance between the bones, but are actually so strong, that when a violent blow is struck upon the Spine, the bones themselves are fractured rather than any rupture of the ligaments, particularly of the intervertebral substance, should take place, as is continually seen in Fractures of the Spine.

d. *In reference to the Motions it performs upon itself.*—In consequence of the form and disposition of the articular processes, and the shortness of their connecting ligaments, the motions performed between any two pieces of the Spine are very slight, with the single exception of one kind of motion between the two uppermost Neck Vertebres. Taken together, however, they are very considerable and very varied, not only in kind, but also as to extent, and as to the mechanism by which they are performed, in the several regions of the Spine. Thus the Neck and Loins, though performing the same kind of motion, differ in the apparatus by which it is effected, whilst the mechanism of the Back is such as almost to preclude motion of any kind.

The simple motions performed by the Spine upon itself are flexion, extension, and lateral inclination; but all three can be successively combined, and thus produce a compound movement called circumduction, commonly though not properly expressed by the term "rolling the body round." If the whole Spine participate in either of these motions, the base from which they commence is the Rump-bone, which is steadied by its connexion with the hip-bones, and the part which is most displaced from its natural position is the upper end of the Vertebral Column. But portions only of the Spine may act, and it is therefore right to consider the motions which each region is capable of performing.

a. Motions of the Neck.—In this division of the Spine the motions are the most extensive and the most varied, and effected by two different kinds of mechanism.

1st. The Atlas and Axis are not connected by interver-

tebral substance, but instead of a body the former has a circular hole completed by the transverse ligament, into which is received the pivot-like process of the latter, and the opposing articular surfaces of both being nearly horizontal, and placed very far forward even upon the top of the body of the Axis, the Atlas travels horizontally upon the latter and around the pivot. This horizontal motion, however, does not exceed an arc of the sixth of a circle, being limited by the lateral ligaments attached to the top of the pivot, and the edge of the great occipital hole, and from this function not inaptly called *moderating ligaments* by some anatomists. The motion is very easily and very briskly performed in consequence of the great length of the transverse processes, which act like the bars of a capstan.

2nd. The remaining Neck Vertebres have the same kind of connexion as the other pieces of the Spine, but modified to increase their mobility. This is effected by the greater elasticity of the intervertebral substance; the quantity of which is, however, less than in either of the other Vertebral regions, admitting the extended play between the vertebral bodies which arises out of the double concave and double slightly convex surfaces which their opposing extremities possess; whilst the looseness of the ligamentous capsules of the articular processes allow greater extent of play, and the shortness of the transverse do not interfere with it. The consequence is, that between every two of these there is greater motion, flexion, extension, and lateral inclination, than between many other Vertebres, and that circumduction is also much more extensive. Besides these there is also a turning of the Neck as it were upon a central pivot from side to side, by which, if the rotatory motion of the Atlas be included, the head is able to describe an arc measuring one-third of a circle.

β. *Motions of the Back.*—As firmness and strength are the great points towards which the mechanism of this region of the Spine is directed, the motions which occur between its several pieces are very trivial. They can indeed bend a little forwards, backwards, or to either side; but to any extent flexion and lateral inclination are prevented by the junction of the ribs, and extension by the overlapping of the vertebral arches and spinous processes.

γ. *Motions of the Loins.*—The quantity of motion here performed is only less than in the Neck; the great distance apart of the bodies and spines, and the shortness of the transverse processes of these Vertebres, admitting of great freedom and extent of motion. The flatness of the bodies of these bones, combined with their free play, would render the Spine at this part extremely weak, and its pieces very liable to displacement, were it not for the beautiful contrivance of the articular processess, which, instead of overlapping or resting against each other, as in the Neck and Back, are actually pegged into one another, the solid half-cylindrical lower processes being received into corresponding concavities on the upper end of the subjacent bone, thus forming a double row of ties, whilst their rounded form allows of slight horizontal rotation upon each other.

ε. *As being the fixed part of the body either to be moved by the locomotive organs, or from which the prehensile organs commence the performance of their functions.*—The former of these purposes is effected by the junction of the Spine with the pelvis or basin, which intermediately connects it with the lower limbs; whilst the latter is brought about by the muscles attached to it keeping the Spine steady in any position required for the advantageous employment of the prehensile organs, so that it forms a resistance upon which, or from which, the muscles moving the upper limbs can act.

2.—OF THE HEAD.

Caput, Lat.; *der Kopf*, Germ.; *la Tête*, Fr.

The Head of the human subject is remarkably distinguished from that of all other Vertebrate Animals by the great size of the brain-case or skull, by the plane of the face being parallel to that of the vertical spine, by the non-projection of the front of the mouth, by the absence of incisive bones, and by the prominence of the chin. It is divided into the skull and face.

Of the Skull (*Cranium*, Lat.; *der Schadel*, Germ.; *la Crâne*, Fr.) (Anat. Pl. V., fig. I. to VI.)

Consists of four single bones, the occipital, sphenoid, ethmoid and frontal, and two pairs, the temporal and parietal.

1. The Occipital Bone (*Os Occipitis*, Lat.; *die Hinter haupts-bein*, Germ.; *l'Occipital*, Fr.) (Fig. I.)

Is situated at the back and under part of the Skull, forming a large portion of the Hind-head and base of the Skull, and transmits the weight of the whole Head to the Spine. It is concave from above downwards, and from side to side in front, and convex in the same directions behind. It is of an hexagonal figure, one sharp angle above and behind, the *occipital* (a.); another before and below, truncated, the *sphenoïdal* (b.); and on each side two,—the upper pair the *parietal* (c. c.), and the lower the *temporal* angles (d. d.). Between these angles the upper two edges are the *parietal* (a. c.), the middle two the *temporal* (c. d.), and the lower two the *basilar* (d. b.). Internally, at the bottom of the bone, is the *great occipital hole* (e.), of an oval form, with its long diameter from before to behind; in front of this rises up the wedge-like process, the *basilar*, which is broad below and narrowing above where it joins to the sphenoid bone, and hollowed from side to side for the lodgment of the annular tubercle of the Brain or great commissure of the Cerebellum, and has a small groove on each of its sides for the inferior petrosal sinuses. Behind the great hole the bone rises and expands considerably, forming four cavities,—the lower two for the lobes of the Cerebellum and the upper two for the posterior lobes of the Cerebrum, and these are divided by a *crucial ridge* (f. f.), the horizontal limb of which gives attachment to the tentorium and lodgment to the lateral sinuses, and the vertical limb above the horizontal receives in it the longitudinal sinus, and gives connexion to the greater falx of the dura mater, and below the horizontal is slightly grooved for the occipital sinus, and has the lesser falx attached to it: upon the upper surface of the temporal angles are grooves for part of each lateral sinus, as they descend to the *great lacerated basal holes*, part of which are formed by notches in the basilar edges. Externally the bone is very smooth above the *great transverse ridge* (h. h.), which passes across in a curving form from one parietal angle to the other, and has in its centre a prominence called the *occipital protuberance* (l.), from which descends to the hind part of the great hole a

sharp low ridge called the *occipital spine* (g.), crossed about an inch below the protuberance by the *less transverse ridge* (i. i.), which curves from one temporal angle to the other, and having between it and the great hole two *pits* for muscular insertion. On each side of the anterior half of the great hole are placed the *condyloid processes* (j. j.), by which the skull articulates with the spine. These are convex from behind to before, deepest in front, and face outwards and downwards; and extending outwards from each is a *ridge* terminating in the temporal angle on each side for muscular attachment; in front of the great hole is seen the under surface of the basilar process.

In the Occipital Bone there are one single and two pairs of holes proper to it.

The Great hole, already mentioned.

The Anterior Condyloid holes before the Condyles, and running into the Lacerated holes.

The Posterior Condyloid holes behind the Condyles, and often only one.

Besides which are found a pair of notches, in the basilar edges, part of

The Posterior Lacerated holes, which are completed by the Temporal Bone.

2 & 3. The Temporal Bones (*Ossa Temporum*, Lat.; *die Schläfe-beine*, Germ.; *les Temporaux*, Fr.) (Fig. II.).

The sides and under part of the Skull, from the temporal angles of the Occipital, and reaching rather before the plane of the Sphenoidal angle of the same bone, are formed by the Temporal Bones, which take their name from being placed in the back part of the Temples of the Head.

The Temple-bone is of very irregular shape, consisting of three distinct parts: the knobby portion, which joins the temporal edge of the Occipital, and is behind the great external auditory opening; the scaly piece, which rises above and before the same aperture, and forms together with the former portion a large part of the side of the Skull; and the triangular piece, of rocky hardness, which runs from the auditory opening inwards and forwards, and is connected by its hind edge with the basilar edge of the Occipital Bone. The *Mamillary Portion* (A.) is named from its large *nipple-like process* (a.), which may be felt like a large knob behind the ear in the living subject: upon its point is a groove for the passage of the occipital artery; on the inner side of its root is the deep *digastric pit;* and behind it is the *mastoid hole:* this process is hollowed out within the Skull, forming a broad deep groove to receive the termination of the lateral sinus. The two tables forming the walls of this portion are far separated, and filled up with numerous cavities containing air, called the *mastoid cells*, and communicating with the internal ear. The upper edge of this portion is nearly horizontal, and deeply toothed. 2. The *Squamous Portion* (B.), so called from its principal part consisting of a large flat scale-like or *squamous plate* (c.), which rises above and before the auditory aperture; it is very smooth on the outer surface, but within irregular with the finger-marks and nipple-like elevations; nearly the whole of its circumference, except at the lower part, is bevelled from without inwards and downwards. From the under, outer, and back part of the Squamous Portion projects outwards and forwards the *zygomatic process* (d.), which terminates in the toothed *malar process* (e.); between the root of the former process and the squamous plate is a smooth surface or *pulley*, over which the temporal muscle plays, and below it is the *glenoid* or *articular cavity* to receive the condyle of the lower jaw, bounded in front by the *articular eminence*, which terminates externally at the *tubercle*. 3. The *Petrous Portion* (C.), of almost rocky hardness, has a prismatic shape, running inwards and forwards from between the Squamous and Mamillary Portions its *upper angle* (e.) is most regular, and has an indistinct groove upon it for the lodgment of the superior petrosal sinus; near its inner extremity is a slight notch, over which the trigeminal nerve passes, and towards the outer an *elevation*, which marks the top of the vertical semicircular canal: in the anterior inferior angle is the bony part of the *Eustachian Tube*, and above it part of the *carotid canal;* in the posterior inferior angle, which is very irregular, there is a deep *notch* completing the *posterior lacerated hole*, which is divided into two by the little jutting *jugular process*, and to its inner side is a conical cavity in which the *aqueduct of the cochlea* terminates: in the front face of the prism is seen the *trigeminal groove*, continued from the notch just mentioned, below it part of the *anterior lacerated hole*, and extending from it outwards and upwards the *unnamed canal*, to terminate in the *unnamed hole*, to the outer side of which is the *front leg of the vertical semicircular canal;* in the hind face, at its inner edge, a slight *hollow*, completing with the basilar process of the occipital bone the groove for the inferior petrosal sinus; to its outer side, the large *internal auditory hole*, and further out the aperture of the *aqueduct of the vestibule*, covered by a plate of bone; in the base or under surface is the *jugular pit*, resembling the cavity of a thimble, into which the jugular vein is received as it joins the lateral sinus (this is usually found only in one Temporal Bone); to its outer side is the long *styloid process* (f.), surrounded by its *vaginal process*, and between it and the digastric pit is the *stylomastoid hole*, to the front of which is the *auditory process*, forming the floor of the *external auditory passage*, which terminates externally in the *external auditory hole*, between the Squamous and Mamillary portions.

In this Bone there are ten holes, of which have been described already—

The Mastoid, Unnamed, Stylomastoid, Internal and External Auditory holes, the terminations of the Aqueducts of the Cochlea and Vestibule, and of the Eustachian Tube. The others are—

The Glenoid hole in the Glenoid cavity, and

The Carotid hole in the base of the prism.

By its junction with the Occipital bone behind, it completes

The Posterior Lacerated hole: and by joining with the Sphenoid bone before,

The Anterior Lacerated hole and

The Internal Carotid hole.

Besides the parts already observed, the Petrous Portion of this bone contains the whole Internal Organ of Hearing, the description of which will be given in treating of the Organs of the Senses.

4 & 5. The Parietal Bones (*Ossa Parietalia, seu Ossa Bregmatis*, Lat.; *die Scheitel-beine, oder Seitenwand-beine*, Germ.; *les Pariétaux*, Fr.) (Fig. III.)

This pair of bones are situated in front of the Occipital, above and projecting a little in front of the

Anatomy. Temporal bones, and form the vault of the Skull, to which the names *vertex*, *sinciput*, or *summit* have been applied.

The Parietal Bone is of a quadrangular figure, convex from above downwards, and from before to behind; its anterior or *frontal* (a.), superior or *parietal* (b.), and posterior or *occipital* (c.) edges are all straight and serrated, or toothed like a saw; its lower or *temporal* (d.) edge, about an inch behind the frontal, assumes a curved form with the concavity downwards, and this curve is bevelled from without to within where received within the bevelled edge of the Temporal bone; consequently, though the one overlaps the other, there is no greater thickness of the skull at this than at any other part; the anterior upper or *frontal* (e.), and the posterior upper or *occipital* (f.) *angles* are right angles; the anterior lower or *sphenoidal* (g.), and the posterior lower or *temporal* (h.) *angles* are truncated. Externally, the bone is smooth, excepting the indistinct curved *temporal ridge*, which, beginning from the middle of the frontal edge, runs backwards and descends into the temporal angle; a projection just above the middle of this ridge indicates the widest part of the skull. Within, the bone is marked by the mamillary eminences and finger-pits, and narrow *branching grooves* point out the ramifications of the middle meningeal artery, the trunk of which is seen in a *vertical groove* on the sphenoidal angle; a *horizontal groove* is observed on the temporal angle for part of the lateral sinus; upon the side of the parietal edge is part of a *longitudinal groove* (i.), completed by the junction of the bone with its fellow for the longitudinal sinus; and to the outer side of this some *pits* for the Pacchionic glands.

In this bone there is but one, the Parietal hole, near the parietal edge, and generally only in one of the bones.

6. The Sphenoid Bone (*Os Sphenoides*, Lat.; *der Keil-bein*, Germ.; *le Sphénöide*, Fr.) (Fig. IV.)

Is placed in front of the Occipital and Temporal bones, forming with the latter the cavities in which the middle lobes of the Cerebrum rest. It is usually said to lock or wedge together all the bones of the Skull, whence is derived its name. It serves, however, the much more important office of connecting the Skull with the Face, being joined with all the bones of the latter, except the Nasal, Lachrymal, and Turbinated, and the Lower Jaw. It somewhat resembles an animal with expanded wings and depending legs; hence has been compared by some anatomists to a bat, and by others to a wasp, but the similarity is not very obvious. It is divided, for convenience of description, into five parts,—the body, two pterygoid, and two temporal portions.

The Body (f.) occupies the middle of the bone, and consists of two *sphenoidal cells*, divided by a middle bony partition; it is placed immediately in front of the basilar process of the Occipital bone, to which it joins by the rough *basilar process* (b.) on its hind part, on either side of which is seen a notch, completing with the temporal bone the *internal carotid hole;* the top of the body is bounded behind by the square *posterior clinoid process*, and before by the *olive-shaped process* (c.), which gives to the hollow between them a saddle-like form, whence it is called the *Turkish saddle;* projecting backwards over the front of the latter are the two little *anterior clinoid processes*, having at their roots the *optic holes;* and extending outwards from these, gradually becoming more slender, and terminating each in a point, are the *transverse spinous processes* (d. d.), sometimes also called the *lesser wings*, or the *Ingrassian processes*, after the anatomist who particularly described them; upon the middle of the front of the body is the *ethmoidal spine* and *crest* (c. a.), the latter of which, descending vertically, has on each side the *openings* of the sphenoidal sinuses; the crest terminates below in the *azygos* or *single process* (e.), a short sharp spur of bone, on either side of which a triangular plate is sometimes called the *triangular bone* (f.), which bounds the top of the *spheno-palatine holes.*

From the under part of the sides of the body descend—

The Pterygoid Portions (i. g.), although so named, correspond to the legs of the flying animal. Each of these are divided posteriorly into two plates by the vertical gutter-like *pterygoid pit*, which at the lower part terminates in the *pterygo-palatine fissure*, by which they are entirely divided; the inner or *nasal plate* (g.) is long, narrow, and terminates in a hook-like or *hamular process* (h.), over which a muscle of the palate plays; the outer or *muscular plate* (i.) is short, wide from before to behind, and turned much outwards: part of the *pterygo-palatine canal* is seen on the front of this portion, into which the *pterygoid holes* run above, and below a rough surface.

The Temporal Portions (j. k. l.) extend from between the body and pterygoid portion on each side outwards for some distance, forming the floor of the middle cavities of the Skull, and terminating behind each in the *spinous process* (j. j.), which is received in a triangular cleft between the petrous and squamous portions of the Temporal bone, and has upon its extreme back and under part the little *styliform process.* Having formed this floor, it ascends vertically on the side of the Skull, and assumes the name of *temporal plate* (k. k.), which forms part of the temporal pit, is joined behind to the squamous plate of the Temporal, and above to the Sphenoidal angle of the Parietal bone: in front of the middle cerebral cavity it also rises vertically, facing forwards and inwards, and, bounding the back and outer part of the orbit, acquires the name of *orbital plate* (l.), between the upper edge of which and the transverse spinous process is the *superior lacerated orbital hole*, whilst its lower edge forms part of the *inferior lacerated orbital hole.* The apertures in this bone are seven pairs, of which the following have been noticed:—

The Optic, Superior Lacerated Orbital, Pterygoid holes, and the openings of the Sphenoidal Sinus. The others are—

The Round holes behind the Superior Lacerated,
The Oval holes behind the last, and
The Spinous holes in the spinous processes.

By its junction with the Temporal bone it completes—

The Internal Carotid and the Anterior Lacerated Basal holes; with the Palate-bone it forms

The Spheno-palatine hole; and with that and the Superior Maxillary bone,

The Inferior Lacerated Orbital holes.

7. The Ethmoid Bone (*Os Ethmoides*, Lat.; *die Siebbein*, Germ.; *l'Ethmoide*, Fr.) (Fig. V.)

Is situated at the bottom of the Skull in front of the body of the Sphenoid bone, between the two Orbits, forming their inner boundaries and the upper part of the Nose. Its upper surface being perforated by nu-

merous holes like those of a colander or sieve, it has acquired the name Ethmoid Bone.

It is of an oblong square form, consisting of numerous bony convolutions, some of which coalesce and form the *ethmoidal cells* (a. a.), which are divided into *anterior* and *posterior*, and others are unconnected, the middle two of which, being very long, are called *turbinated plates;* these cells are bounded on each side by the smooth *flat plates* forming the inner boundaries of the orbits, but which are deficient in front; the upper surface of the bone which forms part of the floor of the Skull is the *cribriform or sieve-like plate* (b. b.), full of very minute holes, which are separated into two sets by an elevated process commencing from the hinder margin and gradually increasing in depth in front, and from its figure called the *cock's-comb* (c.); opposite to which, from the under surface of the cribriform plate descends the *nasal plate* (d.), dividing the ethmoidal cells into two lateral sets; this plate is thick behind to join the ethmoidal process of the Sphenoid bone, then behind and below for the Vomer, thick below and before to receive the septal cartilage of the nostrils, and thick before and above to join the Frontal bone.

Besides the Sieve-holes, there are,—

The Posterior Ethmoidal holes leading to the corresponding sinuses; and parts of

The Anterior Ethmoidal holes, and of

The Internal Orbital holes.

8. The Frontal Bone (*Os Frontis*, Lat.; *die Stirn-bein*, Germ.; *le Frontal*, Fr.) (Fig. VI.)

Occupies the front of the Skull, and forms the Forehead; it is placed before the Parietal bones above and on the sides, before the transverse spinous plates of the Sphenoid, around the sides and front of the Ethmoid bone, and forms the upper parts or vaults of the Orbits. It is usually compared to a clam-shell, the hinge part of which is below and behind, and the convex span of the shell facing forwards.

The bone is naturally divided into two parts by the *ridges* (a. a.) which support the eyebrows, situated at the lower and front part of the bone, and called the *supraciliary*, with a *notch* or *hole* in each: these are arched from side to side, and become more distinct towards the outer part of the orbits, where they terminate in the *external angular processes* (b. b.). On the inner side of the orbits they terminate also in other less defined *processes*, the *internal angular* (c. c.), which latter are separated from each other by a third indented concave surface called the *nasal process*, from the middle of which projects forwards, like the prow of an ancient galley, the *nasal spine* (d.). Behind the nasal process, in the under horizontal portion of the bone, is an oblong square aperture, the *ethmoidal notch,* which receives the Ethmoid bone, and on each side of this are the *orbital plates* (f. f.), of a triangular form, the bases running into the supraciliary ridges, and concave from side to side, forming the vaults of the orbits; some little apertures, the *frontal holes*, are sometimes here noticed, and occasionally near the inner angular process a little stud of bone serving as the pulley of a tendon; between the inner edge of each orbital plate and the ethmoidal notch are a row of cavities, part of the *frontal sinuses* (g. g.), which are perfected by resting on the edges of the Ethmoid bone; on the outer side, near the external angle, is a *hollow* for the lachrymal gland. The upper surface of the bone rises upwards and curves backwards till it joins the frontal edges of the Parietal bones; in front it sometimes, but not always, exhibits a *middle ridge* passing upwards and backwards from the nasal process, a little above which, and extending outwards, are the *prominences* marking the situation of the larger frontal sinuses, and varying in distinctness in different persons; above, and to the outer sides of these, are distinct *prominences* marking the *centres* of ossification of the two portions composing the bone in the young subject; immediately behind the outer angular process on each side is a depression forming the front of the temporal pit, bounded above by the curving of the *temporal ridge*, which is continued from the Parietal bone into the external angular process; on the back surface of this portion, immediately behind the nasal process, is the *blind hole*, and before it commences the *frontal spine*, which, rising up about an inch, divides into two, forming a *groove* which continues up to the groove formed by the junction of the parietal bones, and completes the hollow for the longitudinal sinus. The posterior margin of this bone, as low as the temporal ridges, is serrated and bevelled from behind forwards, but below the ridge from before backwards.

The apertures in this bone are—

The Blind hole,

The Supraciliary holes,

The Frontal holes,

The openings of the Frontal Sinuses. Besides which are formed

The Anterior and Posterior Internal Orbital holes, by the junction of this bone with the upper margin of the Ethmoid.

Of the Face (*Facies*, Lat.; *das Gesicht*, Germ.; *la Face*, Fr.) (Anat. Pl. V., fig. VII. to XIV.).

Consists of six pairs, the Nasal, Superior Maxillary, Lachrymal, Malar, Palatine, and Turbinated Bones, and two single ones, the Ploughshare bone, and Inferior Maxillary Bone.

1 & 2. The Nasal Bones (*Ossa Nasi*, Lat.; *die Nasenbeine*, Germ; *les Os du Nez*, Fr.) (Fig. VIII.)

Are a pair of small bones situated immediately below the middle of the nasal process of the Frontal bone, and forming the Bridge of the Nose.

Each Nasal Bone is fan-shaped; thick and deeply indented above where joining with the Frontal bone, but below very thin where connected with the cartilages of the Nose; its inner anterior edge is straight where joining its fellow, thick above and thin below; and its outer posterior edge grooved where connected with the Superior Maxillary bone; it is slightly hollowed from above downwards, and convex from before to behind externally, and concave in both directions within.

3 & 4. The Superior Maxillary Bones (*Ossa Maxillaria Superiora*, Lat.; *die Oberkiefer-beine*, Germ.; *les Os Maxillaires Supérieurs, ou Sus-Maxillaires*, Fr.), (Fig. VII.)

Are the largest pair of bones in the Face: they are united, form the Upper Jaw, the greater part of the bony Palate, the under and lateral parts of the Nose, and the floors of the Orbits.

The *body* of the Superior Maxillary Bone consists of a large cavity, called the *maxillary cavern*, the inner

wall of which, forming the *nasal plate* of the bone, has in it an aperture called the *maxillary hole;* on the outer side the body is convex from before to behind, and terminates at the hind part in a fulness called the *tuberosity* (b.); from the outer upper part of the body projects a rough indented oblique surface, called the *malar process* (a.), below and to the inner side of which is a depression called the *infra-orbitar pit* (c.), and in it the *infra-orbitar hole;* on the inner, upper, and fore part, a pyramidal *nasal process* (d.) rises up to the inner angular and nasal process of the Frontal bone, with which it joins above, and by its anterior edge with the Nasal bone; on its inner surface is a ridge for the connexion of the Turbinated bone, and behind it a hollow forming part of the *lachrymal pit* and *nasal duct;* below this process is a large notch, completing with that in the opposite bone and with the Nasal bones the anterior opening of the Nostrils; extending inwards from the lower part of the nasal plate, the *palatine process* passes to join its fellow, forming with it part of the *nasal crest* above and the *palatine spine* below, and the fore part of the bony Palate; the outer lower margin of the bone is deepened by the *alveolar process* (e.), consisting of an inner and outer plate connected by transverse plates called the *alveolar plates*, which divide the groove into *alveolar cavities* for eight teeth in each bone, of which the sixth from the front communicates with the maxillary cavern; the upper surface of the bone, forming the floor of the orbit, is called its *orbitar plate* (f.), joining on the inner side the lower margin of the flat plate of the Ethmoid bone, and on the outside forming part of the *inferior lacerated orbitar hole.*

The holes in this bone already mentioned are—

The Infra-Orbitar,

The Maxillary,

The Anterior opening of the Nostrils,

The opening in the sixth alveolar cavity,

The Incisive hole in the front of the palatine process, running into

The Incisive duct, formed by the junction of both bones,

The Nasal duct, partly formed by this bone, and also

The Inferior Lacerated Orbitar hole.

5 & 6. The Lachrymal Bones (*Ossa Lachrymalia*, Lat.; *die Thränen-beine*, Germ.; *les Os Unguis, ou Lacrymaux*, Fr.) (Fig. IX.)

Are a pair of delicate bones, nearly as thin as paper, interposed between the nasal process of the Superior Maxillary and the flat plate of the Ethmoid bone, and covering those cells of the latter bone which are not covered by its flat plate.

The form of each bone is an oblong square; its inner surface is called its *ethmoidal plate;* its outer surface is divided into two by a vertical ridge, which terminates below in a kind of hook: the hinder portion, or *orbitar plate* (b.), is the shorter and wider; the front, or *lachrymal plate* (a.), is the longer and narrower, and completes with the Superior Maxillary bone the pit for the lachrymal sac. It joins the Ethmoid behind, the Frontal above, the Superior Maxillary before and below, and the Turbinated at its extreme lowest point.

7 & 8. The Malar or Cheek Bones (*Ossa Malarum*, Lat.; *die Jock-beine*, Germ.; *les Os des Pommettes*, Fr.) (Fig. x.)

Are situated on the outer under parts of the Orbits, below each outer angular process of the Frontal, and above the malar process of the Superior Maxillary bone.

It is of an irregular figure, has its outer surface convex from before backwards, where it terminates in the *zygomatic process* (a.), by which it joins the same process of the Temporal bone, and completes the *zygomatic arch*, within which the temporal muscle plays; its inner under surface is very oblique, deeply indented, forming the *maxillary process* (b.), to join with the Superior Maxillary bone, and bounded by the *inferior orbitar process* (c.); the bone curves upwards and outwards to form the *superior orbitar process* (d.), by which it is connected with the outer angular process of the Frontal bone, and from behind passes backwards the *internal orbitar process* (e.), forming the outer under part of the orbit, and with the Superior Maxillary, Sphenoid, and Palatine bones completing the inferior *lacerated orbitar hole:* the back of the bone forms part of the *temporal pit* (g.).

There is one hole proper to this bone, the Malar hole, which penetrates its anterior surface.

9 & 10. The Palatine Bones (*Ossa Palati*, Lat.; *die Gaumen-beine*, Germ.; *les Os Palatins*, Fr.) (Fig. XI.)

Are situated in front of the pterygoid portions of the Sphenoid bone, between it and the tuberosities of the Superior Maxillary bones.

Each bone is of very irregular shape, and made up of five processes: the lower and horizontal one is called the *palatine process* (a.), which passing inwards becomes thickened at its inner edge, and joining with its fellow completes with the Superior Maxillary bone above the *nasal crest* (b.) and the floor of the nose, and below the *palatine spine* (c.) and the bony Palate: from the outer edge of this process ascends the *nasal process* (d.), which completes the outer lateral boundary of the nostril, and has upon it a horizontal ridge for the Turbinated bone: the hinder part of this process is triangular, forming the *pterygoid process* (e.), consisting of a middle ridge which enters into the fissure between the inner and outer plates of the pterygoid portion of the Sphenoid, on either side of which is a groove to receive those plates. The top of the nasal process terminates in two small ones: the front one, the *orbitar* (f.), completes the floor of the orbit, and the back one, the *sphenoidal* (g.), rests against the body of the Sphenoid bone, with which the notch between the two last-named processes completes the *spheno-palatine hole*, and descending vertically from it is the *pterygo-palatine canal*, formed by the Palatine and Sphenoid bones, which terminates on the palatine process in two holes—the anterior larger one the *palato-maxillary*, and the posterior smaller the *palatine hole.*

The holes in this bone are the two just mentioned, and the Spheno-palatine by the junction of the Palatine and Sphenoid bones.

11 & 12. The Turbinated Bones (*Ossa Turbinata*, Lat.; *die Muschel-beine*, Germ.; *les Cornets Inférieurs*, Fr.) (Fig. XII.)

Are situated within the Nostrils, upon their outer walls, resting against the Superior Maxillary bones in front, and the Palate-bones behind. They are sometimes called the Inferior Turbinated bones, when the turbinated plates of the Ethmoid bone are described but wrongly, as distinct bones.

The bone consists of a pair of concave plates, with their concavities facing towards each other, and joined

by their upper edge; the outer of these, the shorter and flatter, rests against the inside of the body of the Superior Maxillary and Palate bone, and in front reaches to the lowest point of the Lachrymal bone; the inner plate is the longer and more curved, and depends into the cavity of the nostril.

13. The Ploughshare Bone (*Vomer*, Lat.; *der Pflugschar*, Germ.; *le Vomer*, Fr.) (Fig. XIII.).

Extends from the under part of the body of the Sphenoid to the nasal crest of the Superior Maxillary and Palate bones, dividing the Nose into the two cavities or Nostrils. Its figure very much resembles a ploughshare, and its direction increases the similitude; its upper or *sphenoidal* (a.) edge is broad and short, and has in it a depression to receive the azygos process of the Sphenoid bone; its hinder or *pharyngeal* (b.) edge is knife-shaped and hollowed out; its lower or *cristal* (c.) edge is hollowed to receive within it the nasal crest, and its anterior or *septal* (d.) edge is hollowed to receive the septal cartilage of the Nose below, and the nasal plate of the Ethmoid bone above.

14. The Lower Jaw (*Os Maxillare Inferius*, Lat.; *die Unterkiefer-beine*, Germ.; *le Maxillaire Inférieur*, Fr.) (Fig. XIV.)

Is a large single bone forming the Lower Jaw, placed below all the other bones of the Head, and forming the lower boundary of the Face.

It resembles the letter U placed horizontally, with its convexity facing forwards; whilst the branches before their termination are bent upwards at right angles, and hence has originated the division of the bone into its *horizontal* (a. a.) and *ascending branches* (f. f.). The horizontal branches meeting in the front convexity form the *symphysis* or *chin* (b.), the front of which projects somewhat, and at its back are one or two little processes, called the *mental spine*; from the chin pass backwards the *sides* of the bone which terminate in the *angles* of the jaw; the lower edge of the sides and chin are rounded, and the upper is furnished with an *inner* and *outer alveolar* or *gum processes*, connected by alveolar plates, which leave between them sockets for the teeth, like those in the Superior Maxillary bones; on the inner surface of each side of the bone is a ridge for muscular attachment, and at the outer side, near the angle, a distinct roughness for the same purpose. The ascending branches rise nearly vertically, are wide from before to behind, flattened laterally, and terminate in two processes, separated from each other by a concavity; they are nearly of a height. The hinder one, the *condyloid process* (e. e.), is expanded laterally, and convex from behind to before, corresponding with the socket in the Temporal bone, and below it the bone is constructed to form its *neck* (f. f.). The front or *coronoid process* (g. g.) resembles the point of a knife, and has attached around it the tendon of the temporal muscle; this process runs sharply down to near the last alveolar cavity, and is then divided into two legs, which are lost, one on the alveolar process and the other on the side of the jaw; about half an inch below the notch, and covered by a small plate of bone, is the *inferior maxillary hole* (h. h.), which is the entrance of a canal running beneath the sockets of the teeth as far as the second bicuspid tooth, where it terminates on each side in the *mental hole* (i. i.).

The holes in this bone are the two pair just mentioned, viz., the Inferior Maxillary and the Mental.

Junction of the Bones of the Head.

None of the bones of the Head, except the Temporal and Lower Jaw bones are connected by true joints, *i.e.*, ligamentous capsules lined with synovial membrane, but are for the most part united by the corresponding edges of the several bones, being toothed like a saw, and the teeth received into the alternate notches, the fibrous covering of the bones being only interposed. This kind of junction, having the appearance of the bones being stitched together, has obtained the name of *Suture*, a term more generally applied to the union of the large bones of the Skull, whilst the more delicate union of those of the Face are generally called *Harmonies*, although in reality there is no difference, except in the fineness of the toothing of the bones. In some few instances two bones overlap each other, the edges of each being bevelled off, so that there is no increased thickness at their junction; such is the case with part of the union of the Temporal with the Parietal bones, and of the Turbinated with the Superior Maxillary bones.

Of the Sutures of the Bones of the Skull there are seven.

1. The *Coronal Suture*, named from being near the part upon which the victor's crown was placed in the games of the ancients. It commences about an inch behind the outer angular process of the Frontal bone, at the middle of the upper edge of the temporal plate of the Sphenoid bone, passes upwards and slightly backwards to the crown of the head, and descending forwards terminates at the opposite point to that whence it commenced, having in this course connected the hind edge of the Frontal with the frontal edges of both Parietal bones.

2. The *Sagittal Suture*, from its direction backwards straight as a dart, commences from the middle of the Coronal, passes back to the occipital angle of the Occipital bones, and connects the parietal edges of the Parietal bones.

3. The *Lambdoidal Suture* resembles the Greek letter Λ; its angle abuts on the hind part of the Sagittal, its branches pass downwards and forwards on each side, and terminate in the anterior inferior lacerated holes of the base of the Skull, connecting the parietal, temporal, and basilar edge of the Occipital bone on each side with the occipital edge of the Parietal, with the hind and under part of the Maxillary portion, and with the hind edges of the petrous portion of the Temporal bone.

4 & 5. The *Squamous Sutures*, formed by the scale-like overlapping of the squamous part of the Temporal bone and the temporal edge of the Parietal bone on each side, which describes the extent of these sutures.

6. The *Ethmoidal Suture* exists in the junction of the margin of the cribriform plate of the Ethmoid, with the notch between the orbitar plates of the Frontal bone.

7. The *Sphenoidal Suture* is the most important and most extensive of any in the Skull, and consists of the junction of this with all the bones of the Skull; by the upper edge of its temporal plates it joins the sphenoidal angles of the Parietal and that part of the Frontal which belongs to the temporal pits; by the posterior and under edge of these plates as far as the spinous processes it joins the front of the squamous portions of the Temporal bones, and thence to the body joins the fronts of the petrous portions of the same bones; the back of the

body joins the sphenoidal angle of the Occipital bone, and its front joins the back of the Ethmoid bone, extending outwards from which the transverse spinous processes join the back of the orbitar plates of the Frontal bone.

One suture, which connects the Skull to the Face, from its direction is called

The *Transverse Suture*, but a better name for it would be the *Rectangular*, the angle being situated at the junction of the pterygoid portions with the body of the Sphenoid bone. The horizontal leg connects in the middle the Vomer with the body of the Sphenoid and with the nasal plate of the Ethmoid; on each side of which the sphenoidal process of each Palate-bone joins the body of the Sphenoid, and the orbitar process of each Palate and superior Maxillary bone joins the lower edge of each orbitar plate of the Ethmoid and Lachrymal, and having reached the nasal processes of the Superior Maxillaries, ascends, connecting their hind edges with the front edges of the Lachrymal, and then running across the top of the bridge of the nose connects the top of the nasal processes of the Maxillaries and the tops of the Nasal bones with the nasal processes of the Frontal bone. The remaining part of this horizontal leg connects the hind part of the inner orbitar processes of the Malar bones with the front of the orbitar processes of the Sphenoid and the outer angular processes of the Frontal bone. The vertical leg of the Suture connects the front of the pterygoid portions of the Sphenoid with the pterygoid processes of the Palatine, and the tuberosities of the Superior Maxillary bones.

The Harmonies of the Face

Are sufficiently described by enumeration, their generally compound names indicating the bones they connect.

The *Nasal*, *Maxillary*, *Palatine*, } connecting the pairs of bones;

Naso-Maxillary, *Lachrymo-Maxillary*, *Palato-Maxillary*, *Malo-Maxillary*, *Turbo-Maxillary*, { connecting severally the Nasal, Lachrymal, Palatine, Malar, and Turbinated with the Superior Maxillary bones;

Septal, connecting the Vomer with the Superior Maxillary and Palatine bones; and

Zygomatic, connecting the Malar with the Temporal bones.

3.—OF THE CHEST.

Thorax, Lat.; *der Brustkasten*, Germ.; *la Poitrine*, Fr. (Anat. Pl. III., fig. XVIII. to XXVII.)

The Chest forms the upper of the great cavities of the Trunk, and consists of thirty-nine bones,—viz., twelve pairs of Ribs connected behind with the twelve Vertebres of the Back already described, and before with the three pieces of the Breast-bone.

THE RIBS (*Costæ*, Lat.; *die Rippen*, Germ.; *les Côtes*, Fr.) (Fig. XIX. to XXI.)

Are disposed in pairs below each other, and vary considerably in form. Generally they resemble segments of a circle, or of an oval, according to their position, the upper affecting a semicircular, and the middle a semi-elliptical form, whilst the lower are but small arcs of large circles. No two of the same side are of equal length; the seventh is the longest, and from it the other ribs diminish both upwards and downwards. Excepting the first pair, which are flat from above to below, all are compressed in their middle part, which is called the *body* (a.), with their upper edge round and their lower sharp and hollowed within, forming a deep groove for the lodgment of the intercostal vessels and nerves: the eleventh and twelfth pairs (fig. XXI.), however, are distinguished by having both upper and lower edges sharp. By their hinder extremities all the Ribs are connected to the Dorsal Vertebres, the upper ten doubly and the lower two singly. The double union of the former is effected by a joint-surface on the extremity of the bone called the *head* (b.), which in the first, eleventh, and twelfth Ribs is single and attached to the bodies of the first, eleventh, and twelfth Back Vertebres; but in the other nine pair the joint-surface on the head is double, each head being received not on a single Vertebre but on a shallow cup formed by the lower edge of one and the upper edge of the subjacent Vertebre, and perfected by the ligamentous structure connecting their bodies. The upper ten pairs are also further connected to the Spine, each by a little jutting process called the *tubercle* (c.), placed where the ribs bend forwards, and which has a joint-surface corresponding with that upon the transverse processes of the upper Dorsal Vertebres. The remaining two lower Ribs have no tubercles, because the Spinal pieces with which they are connected have very small transverse processes. The fore extremities (d.) of all the Ribs are more or less deeply hollowed to receive tough gristles, which have the general form of their bodies; by these the upper seven pairs are directly connected with the Breast-bone; the following three with the seventh pair of Ribs and with each other, whilst the lowest two pairs are unconnected except with the muscles of the belly; and hence the Ribs are divided into *true*, *false*, and *floating*. With regard to the position of the Ribs, neither can be said to be strictly horizontal. The first pair have the greatest pretension to that arrangement; but even in them, except under a very peculiar state of inspiration, the fore extremity is lower than the hind one, and all the other pairs depend successively more and more as they approach the lower part of the Chest.

THE BREAST-BONE (*Sternum*, Lat.; *der Brust-bein*, Germ.; *le Sternum*, Fr.) (Fig. XXII.)

Consists of three consecutive pieces, situated in the middle of the front of the Chest; of these the lowest piece often remains gristly or cartilaginous throughout life, and is never ossified but at a very late period. The general form of the Breast-bone is that of a short Roman sword; the handle being formed by the first, the blade by the second, and the point by the third, or cartilaginous piece,—hence it is called the *Sword-like* or *Ensiform Cartilage*; but the connexion of these pieces is so firm, that although admitting of slight yielding which diminishes the shock of any blow received on the chest, yet for the purpose of sustaining the fore extremities of the ribs it is fully efficient.

The *first piece* (a.), often called the handle or *manubrium*, is of a triangular form, with all its angles truncated; its base is placed upwards at the bottom of the Neck, interposed between the two Collar-bones, which it receives upon its two angles (d. d.), semilunarly hollowed for that purpose, whilst its truncated tip is joined to

The *second piece* (b.), the blade or body, *corpus*. This

is of a lengthened form, rather narrower at the upper than at the lower end, where it joins with the *third piece* (c.). On each side of the Breast-bone thus formed, besides the sockets for the Collar-bones, are shallow hollows in which the gristles of the seven true Ribs are received; and of these one pair and one half pair are seen on the first piece, four pairs and two half pairs on the second, and one half pair on the third piece.

Of the Thoracic Joints (Figs. XXIII. to XXVII.).

The two bony pieces and the sword-like Cartilage of the Sternum are connected together by thin cartilage, and this junction is strengthened by ligamentous bands which pass from above to below on both surfaces of the bone.

The heads of all the Ribs are connected to the bodies of the Vertebres by *capsular ligaments*, the sockets upon the latter being formed in all except the first eleventh and twelfth Dorsal, by the half articular surfaces on their edges connected by the Intervertebral Substance, from which a short flat band (a. e.) is extended to the horizontal ridge upon the head of each Rib, and divides the capsule into two distinct cavities lined with synovial membrane. The three excepted pairs of Ribs being received on whole sockets, as already mentioned, have not this band, and therefore the synovial capsule is single. The fronts of these capsular ligaments are materially strengthened by ligamentous bands, which, originating from the front of the Neck of each Rib, pass in three packets, one to the Vertebre above, another to that below, and a third between these to the interposed Intervertebral substance: from this spreading form they are called the *radiated* ligaments.

The tubercles of the upper ten pairs of Ribs are also connected to the corresponding transverse processes of as many Vertebres by *capsular* ligaments; and this junction is further strengthened by three ligaments, 1. The *posterior costo-transverse* (d.), a short thick one which extends from the outside of the root of the tubercle to the point of the transverse process with which it articulates; 2. The *middle costo-transverse* (c.), which connects the back of the neck of the Rib with the front of the same transverse process; 3. The *anterior costo-transverse* (f.), which, arising from the whole upper edge of the Neck, is attached to the under edge of the transverse process of the Vertebre above.

The sternal or fore extremities of the upper seven pairs of Ribs are joined directly to the Breast-bone by as many Cartilages, and the three following indirectly by successive junctions with each other, and the connexion of the upper with the seventh. The lowest two are not in any way connected with the Breast-bone, but merely tipped with Cartilage to prevent injury to the muscles among which they move. The length of the connecting Cartilages differs materially; the first pair are very short, but thence they increase to the seventh pair, which are the longest. In size and form they nearly resemble the extremities of the Ribs to which they are attached, and above the sixth the two extremities of each are rather deeper than the middle, but below it the fore end is shallower than the hind; and, indeed, those of the eighth, ninth, and tenth, which rest against each other, are pointed. Like the fore ends of the Ribs, their greatest diameter is vertical, with the exception of the first pair, which assumes the nearly horizontal position of the Ribs to which they belong; and the second pair are intermediate between the first and the others. Their direction also from the Ribs to the Breast-bone differs materially in reference to their position: the first pair follow the curve of the uppermost Ribs, and join the Breast-bone rather obliquely from above and without downwards and inwards; the second abut on the same bone at right angles; the third and following, including the seventh, ascend from below and without upwards and inwards, their junction with the Ribs being further below their sternal junction as they descend. The junction of the Cartilages with all the Ribs is direct, their costal extremities being rather semi-elliptical, and received into corresponding cavities, the margins of which overlap them; it is the kind of junction technically called a *symphysis*, or flowing together of parts. Their connexions with the Breast-bone are on the contrary true joints, *ligamentous capsules* lined with synovial membrane; but the capsules are so short that scarcely any motion is performed between them and the Sternum. The first pair of Cartilages, however, are joined to the Breast-bone directly by Symphysis, and not by a true joint. The capsule of the second pair exhibits a remarkable analogy to those connecting the middle Ribs and the Dorsal Vertebres, in being divided into two by the ligamento-cartilaginous structure which connects the upper and second portion of the Breast-bone, sending a process to the sternal end of the Cartilage. The capsules of all these Cartilages are strengthened by ligamentous fibres, which, passing inwards from them, run upon the front and back of the Sternum, and are lost in its periosteal covering. The Cartilages of the false Ribs are joined successively to the under edge of the Cartilage above them by cellular tissue, which is the shortest between the seventh and the eighth, and the longest between the ninth and the tenth; and each is connected further outwards, that is, nearer the fore end of the preceding Rib than the other. The effect of these two circumstances is, that the lower they are the more movable, and the wider the diameter of the Chest.

The use of the Cartilages is two-fold; *first*, to allow more extended motion in the Ribs, which, when elevated, by twisting the Cartilages outwards and forwards, project their fore extremities, and thereby increase the size of the Chest from before to behind more than they could have done had the Ribs, Cartilages, and Breast-bone been mere osseous rings movable only at their Vertebral extremities; and *secondly*, by their elasticity, to break or diminish the shock of blows received upon the Chest, which but for them would probably cause fracture of one or more of the Cotsal Rings.

The connexion of the last two pairs of Ribs, the floating Ribs, as they are commonly called, from their fore extremities running in among the muscles, and unattached to the Cartilages above, is merely to the bodies of the eleventh and twelfth dorsal Vertebres by capsular ligaments. They are not connected by any true joints to the small transverse processes of those Vertebres, but to the transverse processes of the upper two Loin-Vertebres by a ligament of an arched form, broad at its origin from those processes, and narrowing as it ascends outwards to be attached as far as the tips of those Ribs.

General Observations relating to the Chest.

As to Form.—The shape of the Chest nearly resembles a truncated cone, flattened before and behind, and rounded on the sides. Its truncated apex forms the lower boundary of the Neck, presenting an oval aper-

ture, with its long diameter from side to side, and its plane facing forwards and upwards. The base faces downwards, or nearly so, and is very capacious, but its front is deficient as high as the tip of the Breast-bone, which scarcely descends below the sixth pair of Ribs; and as those below diminish in length, a large triangular gap is left.

As to Capacity.—The cavity of the Chest is not so capacious as might at first be supposed; for although with regard to the whole Spinal Column the Dorsal Vertebres, which form the hind part of the Chest, recede, yet their bodies project considerably into its cavity, or, in other words, the curving portions of the Ribs at their angles extend far behind these Vertebres; the effect of which is to assist the equipoise of the Trunk by placing a considerable part of the muscular coverings of the Chest behind the supporting Spinal Column. A vertical section of the Chest gives a ready explanation of this arrangement as to equipoise, whilst a transverse section, which has no very indistinct resemblance to the heart on playing cards, shows how the encroachment upon the cavity is fully compensated by the enlargement of the Chest on either side behind the Spine. It must, however, be borne in mind, that in a well-formed Chest the front, or Breast, as it is usually called, has no resemblance to the point of the card-heart, but is, on the contrary, very broad; and any diminution of this breadth, which is accompanied with corresponding projection of the Breast-bone, produces that unnatural and unhealthy form of the front of the Chest commonly known as a *Chicken-breast*, in consequence of which the cavity of the Chest is materially diminished.

As to Motion and Variation of Capacity.—It is not to be supposed that during respiration the Ribs either remain fixed in one position, or that when moved in *inspiration* they are raised up to one another like the pieces of a Venetian blind, and again separated in *expiration*. Were it so, there would be no increase in the size of the Chest in the former case, nor diminution in the latter, at least so far as the bony structure is concerned. But in inspiration there is an actual increase of the capacity of the Chest by the extension of its bony walls, which is effected by the simple and beautiful mechanism enabling the Ribs and Breast-bone to perform a swinging motion upon the Spine. It must be recollected that none of the Ribs are articulated horizontally with the Spine; even the first pair have their front lower than their back part, and this declination continues more and more till it acquires its greatest variation at the last pair. Any elevation, therefore, of their anterior extremity increases its distance from the Spine, and consequently increases the capacity of the Chest from behind to before, as the Ribs are raised towards a more horizontal position than they possess when at rest. The capacity, therefore, of the Chest is increased by the fore extremities of the Ribs being swung upwards; the heads of these, moving upon the Spine, form the axes of as many pairs of rods, the bodies of Ribs themselves, as are connected with the boat of the swing represented by the Breast-bone and its connecting cartilages. In Quadrupeds which have the Dorsal portion of the Spine horizontal, the comparison is very close, the Ribs depending like the rods of a common swing, whilst the Breast-bone is thrown forwards and backwards when they are put into action by the muscles of respiration. But in Man, who has the Spine erect, the swing-like motion, though still simple, is rather more complicated, because requiring a fixed point from which the swinging motion is to be initiated. This is provided in the first or uppermost pair of Ribs, which, connected by very short Cartilages to the top of the Breast-bone, and also to the first dorsal Vertebre, forms with those bones a strong ring, retained in its place above by powerful muscles antagonizing the weight of the lower Ribs and muscles attached to them, which have a constant tendency to depress it, and except under peculiar states of respiration has very little motion, and forming the fulcrum upon which all the other Ribs are moved, the elevating muscles of the second Rib rendering its front part more horizontal, and so on throughout the whole descending series, which are more and more raised as their anterior ends are more widely separated. At the time the fore part of these Ribs are being raised, in consequence of their cartilaginous connexion with the Breast-bone, they project it forwards, more especially near its tip, on account of the elevation of the Ribs being greater there than at the upper part, and consequently the capacity of the Chest is more enlarged comparatively at this point than it is above. Such is the mechanism as regards inspiration, and expiration is merely the reverse of these motions, with this only difference, that the mere weight of the lower part of the Chest restores its original position without any necessity for muscular exertion. It may, however, be briefly observed, that the Cartilages of the Ribs take part in the initiative of expiration: when the Ribs have been elevated, the cartilages undergo a kind of twist outwards; whilst this elevation is continued, their elasticity is constantly acting to recover their natural position, and by doing this they depress the ends of the Ribs connected with them.

4.—OF THE LIMBS.

Extremitates, Lat.; *die Gliedmasse*, Germ.; *les Membres*, Fr.

The Limbs of Man are divided into Lower and Upper, and their organization is subservient to certain special purposes, in consequence of which, strictly speaking, neither participates in the functions of the other. This remarkable peculiarity distinguishes them from all other animals.

By the beauty and perfection of their form, and the delicacy of the motions consequent thereon, especially those of the Upper Extremities, the Limbs of Man are far separated from those of other animals, and decidedly indicate his claim to the highest rank in the works of Creation. Two of the principal and peculiar characters which distinguish him are dependent on the arrangement of the Limbs. These are, his erect posture and the complicated functions of his Upper Extremities, with neither of which can any parallel be found in those parts of other animals. In a large portion of them the erect posture is physically impossible, as in the greater number of Beasts or Mammiferous Animals; and even in the few which affect this position, the arrangement of the Skeleton is so little suited to it, that the attempt, even for a very short time, is made only with severe exertion, and then imperfectly, as seen in the Monkey Tribe of the Four-handed or Quadrumanous Order of Beasts. The so-called erect position of Birds is not really an erect posture; for the trunk, instead of being vertical with relation to the feet, which form the base of support, is

more or less at a right angle with them, and part even of the Lower Limbs themselves have, to a greater or less degree, a horizontal disposition. And with regard to Reptiles and Fishes, the horizontal position of the whole body always obtains. Again, the Upper Limbs in all other animals are properly called Fore Limbs, being entirely or partially employed in the support and progression of the body, and in a very large proportion serve only these purposes. In Man, however, their functions are entirely different, and the principal one is that of instruments by which a vast variety of offices can be performed by them alone, which in animals are either effected only by the consentaneous employment of several organs, or not performed at all.

A.—Of the Lower Limbs, or Passive Locomotive Organs.

Extremitates Inferiores, Lat.; *die Unteren Extremitäten, oder Bauchglieder*, Germ.; *les Membres Inférieurs*, Fr. (Anat. Pl. III. and IV.)

The Lower Limbs consist of the Basin or Hip-Girdle, the Thighs, Legs, and Feet.

1. The Basin or Hip-Girdle (*das Bechen*, Germ.; *le Bassin*, Fr.) (Pl. III., figs. xxviii. to xxxv.)

The Hip-Girdle, Basin, or Pelvis, as it is generally called, forms at once the lower great cavity of the Trunk, and the medium of connexion between the Trunk and the Lower Limbs, specially so called. It consists of four bones—the Rump and Tail Bones, already described (p. 383), and the two pelvic bones.

The Pelvic, or Hip Bones (*Ossa Coxarum, seu Innominata*, Lat.; *die Huft-beine, oder Seitenbeinknocken*, Germ.; *les Os Iliaques*, Fr.) (Fig. xxviii. to xxxii.)

Are a pair of bones which occupy the fore and side parts of the lower portion of the Trunk, and are of very irregular form.

The largest part of the Bone is expanded in a fan-like shape, and its margin forms the Hip, commonly so called. Its comparative size is greater than in any other animal, because required to give attachment to the large muscles which preserve the vertical position of the Trunk upon the tops of the Thigh-bones. It has upon its inner and back part a large joint-surface, which closely connects it with the Rump-bone, whilst before and below it becomes thick and bulky, to admit the sinking of the *concavity* of part of the socket (r.) of the Hip-joint. It has also four little jutting processes called *spinous*—two in front, the *superior* (a. a.) and *inferior anterior* (b. b.), and two behind, the *superior* (c. c.) and *inferior posterior* (d. d.); and between the upper of these is the thick upper margin of the bone, called its *crest* (e.). The outer surface of the bone is called its *back* (f.) and the inner its *belly* (g.), bounding the lower part of the latter of which is a blunt ridge called the *ilio-pectineal line* (h.). This portion of the Pelvic bone is anatomically named the Hip-bone (*Os Ilii*, Lat.; *das Darm-bein, oder Huft-bein*, Germ.; *l'Os de îles*, Fr.), and it is joined to the Hip-socket by an irregularly oval ring forming the front of the bone, and described as consisting of two pieces, the Haunch-bone and the Share-bone. It must, however, be observed, that in the adult state the Pelvic bone is really not composed of three pieces, although such is the case in the young subject, from which circumstance anatomists have been pleased to describe it as three separate bones, an erroneous proceeding, which has been followed by almost every writer on the subject. The upper and inner part of the already mentioned bony oval is called the Haunch-bone (*Os Pubis*, Lat.; das *Sham-bein*, Germ.; *le Pubis*, Fr.); the most remarkable points of which are its thick concave part, where joining with the Hip-bone, to form the inner upper part of the Hip-socket (r.), thence extending inwards horizontally, its *body* (i.) terminating at its *angle* in the descent of the *leg* (l.) of the bone, the inner and upper part of which is broad and irregularly rough to join its fellow, and form the *symphysis* (k.). The upper edge of the body is sharp and narrow, completing in front the *ilio-pectineal line*; whilst the fore and upper surface of the same part is flat, for the passage of the blood-vessels from the belly into the thigh. The leg of the Haunch-bone, as it descends, inclines outwards, and soon assumes the name of *leg* (l.) of the Share or Sitting bone (*Os Ischii*, Lat.; *das Sitz-bein*, Germ.; *l'Ilion*, Fr.), which forms at the lower part of the Pelvic bone a large swelling process called the *tuberosity* (m.), on which the body rests in the sitting posture, and rising again upwards and outwards, expands to form the upper part of the Hip-socket, from behind which projects its *spinous process* (n.), dividing the hinder and lower margin of the bone into two notches, called the *lesser* (o.) and *greater ischiatic*. (p.). Between the lower edge of the Hip-socket and the tuberosity, there is a horizontal groove for the passage of a muscle.

Two parts, formed in the Pelvic bone, require notice.

1st. The Oval hole (q.), *foramen ovale, seu thyroideum.* This is produced by the pubic and ischiatic portions, and its oval area, as will be hereafter noticed, is filled up with ligament, for which purpose its inner margin is thin. The object of this hole is to lighten the bone as much as possible, without diminishing its strength.

2nd. The Hip-socket (r.) (*Acetabulum*, Lat.; *die Pfanne*, Germ.) is made up by the union of all three portions of the Pelvic bone, but not in equal parts, as the fore and inner fifth only belong to the Haunch-bone, whilst the rest is nearly divided equally by the Hip-bone above and behind, and the Share-bone below and before; the latter, however, has the larger proportion. The form of this socket resembles a deep cup, and from its fancied likeness to an antique vinegar cruet has received the name of *Acetabulum.* The plane of its diameter faces forwards, a little outwards and rather downwards, in consequence of which the upper edge of its lip overhangs the lower, and provides a large surface to rest on the head of the Thigh-bone. The margin of this cavity is deficient at the inner and under part, which, however, in the recent state is perfected by a strong ligament. By this formation greater extent of motion is allowed to the thigh than could be otherwise enjoyed. The greater part of the cavity is smooth; but, from the notch, a broad shallow depression is scooped out as far as the middle.

The Pelvic bones, connected together in front, are separated from each other behind by the Rump-bone, and these, together with the Tail-bone, form the Basin or Pelvis; but before treating of this cavity, it will be necessary to describe the junctions of these bones, or—

The Pelvic Joints (Fig. xxxiii. to xxxvi.).

The Rump and Tail bones are common to the Spine and Pelvis. With the former they complete the pillar supporting the Trunk, and the canal in which the Spinal Cord is lodged; whilst at the same time they, the Rump-bone especially, form the hind part of the latter, the crown of the arch by which the Trunk is supported upon the Lower Limbs. Such being the use of the Pelvis, it is to be expected that the junction of the bones composing it should be of the firmest kind, as is actually the case; the only motion permitted between them being a slight yielding to diminish the shocks to which the Pelvis must naturally be exposed by its position between the Trunk above and the Lower Limbs below.

The Pelvic bones are connected by the broad irregular joint-surfaces at their inner and hind part with the corresponding surfaces on the sides of the Rump-bone, a very thin layer of fibro-cartilage, in some parts so soft as almost to resemble the mucous-like centre of the Intervertebral Substance, being interposed. Over the front and back of this so-formed junction, bands of ligament, flat and expanded, extend from the surface of one bone to the other, and are lost in their periosteal covering; these, from their position, are called the *Anterior* (c.) and *Posterior Sacro-iliac Ligaments* (b.).

The Pelvic bones are also joined to the Spine by two short stout ligaments originating from the superior posterior spine of the Hip-bone, and called the *Inferior* and *Superior Ilio-lumbar;* the former attached to the transverse process of the last Lumbar, and the latter to the same processes of the two lower Lumbar Vertebres. The connexion of the Hip-bones with the Sacral and Coccygeal parts of the Spine is further strengthened by two pairs of very strong ligaments of a triangular shape, called *Sacro-ischiadic*, the *anterior* (e.) of which has its base connected with the side of the last segment of the Rump-bone and of the three upper pieces of the Tail-bone; it passes outwards, collects together, and forms a thick flatttened mass which is fixed into and around the spine of the Share-bone, on which account it is often called *Sacro-spinous.* The other, or *posterior* (f.), is much larger and stronger; its base is attached to the lower posterior spine of the Hip-bone, to the side of the transverse processes of the three lower segments of the Rump-bone, and to the first of the Tail-bone; it curves behind the anterior, collects together into a broad flat band as it passes down to be spread upon the tuberosity of the Share-bone, where it is confounded with a large mass of fibro-cartilage by which that process is covered; from its connexion it is also called the *Sacro-tuberose Ligament.* By the extension of these ligaments between the Rump and Tail bones above and the spine and tubercle of the Share-bone below, the notches existing in the latter are formed into complete holes, the *Superior* (p.) and *Inferior Sacro-ischiadic* (o.), for the passage of muscles, vessels, and nerves.

The junction of the Share-bones in front, completing the ring of the Basin, is by concentric elliptical layers of ligamento-cartilaginous substance (i.) like that between the Vertebres, closer and tougher at the circumference, but almost mucoid in the centre; the fibres of this structure are horizontal, and the long axis of their oval vertical corresponding with the joint-surfaces of the bones connected. From one Haunch-bone to the other, ligamentous fibres (g.) cross and decussate in every direction on the surface of this structure, which they materially strengthen; and so firm is the connexion of this mass to the bones, and so great its strength, that they are rarely separated from the bones, or torn in two, the bones themselves commonly being fractured in preference.

The Oval holes in front of the Pelvis are filled up with ligamentous expansions, which are called the *Thyroid* or *Obturator Ligaments* (h.), and have at their upper and outer part an aperture through which pass vessels and nerves.

By the junction of the Pelvic-bones with the terminal pieces of the Spine is formed

The Basin (*Pelvis*, Lat.; *das Becken*, Germ.; *le Bassin*, Fr.),

The second bony cavity of the trunk. It is a hollow cylinder, the upper part of which is much outspread on the sides by the bellies of the Hip-bones, but is deficient in front as low as the pubic symphysis, from which, extending round on either side to the Rump-bone, are the *Ilio-pectineal lines;* these, taken together with the projecting front lip or *promontory* of that bone, form a ridge somewhat resembling the outline of a card-heart, which is called the *Brim* or entrance of the Basin, and divides it into parts, the False and True Basin.

The *False Basin* (fig. xxviii. g. g. i. i.), situated above the Brim, has no bony walls in front, but its sides are formed by the expansions of the Hip-bones, and its back by the lower Lumbar Vertebres.

The *True Basin* (h. h.) is below the Brim, which forms its upper opening, and has a somewhat circular or oval form, according to the sex; the former being the characteristic of the male and the latter of the female. The front and sides are formed by the Haunch and Share bones, and the back by the Rump and Tail bones. They do not, however, form a complete bony boundary, but only, as it were, three bony angles depending about an inch below the margin of the Brim, and terminating in the tuberosities of the Share and the tip of the Tail bone. The divergence of the tuberosities leaves an angular space in front, commonly called the *Arch of the Pubes;* and between them and the Rump and Tail bones behind are a pair of holes, the Inferior and Superior Ischiadic, bounded below by the attachment of the ligaments of the same name. The hinder or lower opening of the True Basin is called the *Outlet* (fig. xxxi.); it is of a quadrangular shape, the angles being formed on the sides by the Ischiatic tuberosities, behind by the tip of the Tail-bone, and before by the Pubic joint.

The plane of the Brim of the Pelvis is not horizontal, for if it were the weight of the Trunk received on the Rump-bone would throw the body backwards; but it faces forwards and upwards, and the Outlet is nearly parallel to it. This arises from the superior anterior spinous processes of the Hip-bones touching the same vertical plane as the top of the Pubic joint, which make the Ischiatic tuberosities the lowest points of the Pelvis, and indeed the only parts upon which the body rests in the sitting posture, and through them passes the imaginary plane which drops from the basilar process of the Occipital bone through the

Ankle-joints. The Axis of the Pelvis is a line which passes through the centres of the Brim and Outlet, and if continued upwards and forwards would pierce the Navel. These are points of great importance not merely with reference to the mechanical offices of the Basin, but also in relation to many practical points in Surgery and Obstetrics.

General Observations relating to the Basin.

First, *As being the means by which the weight of the Trunk is transmitted to the Lower Limbs.*—With reference to this circumstance, a horizontal line must be supposed to pass from one side to the other below the Hip-sockets; these will then form two pieces, from which springs up an arch consisting of the upper part of the brim, the keystone of which is the Rump-bone, received between the Iliac portions of the Pelvic bones. The bases of the piers are connected firmly together by the front of the Basin, so that, being unable to start aside, they afford an upward pressure, and, resisting any weight with which the arch is loaded, materially strengthen and assist in keeping the whole bony ring of the Basin together. The weight of the Head, Trunk, and Upper Limbs being deposited on the Rump-bone by means of the Spine, is transferred to the bases of the piers, namely, the Hip-sockets, which rest upon the heads of the Thigh-bones, and with the object of more perfectly steadying this junction, and to guard against any falling outwards, the outer margins of the Hip-sockets are much developed and overlap the heads of the Thigh-bones.

Secondly, *As being the fulcrum on which the motions of the Lower Limbs are performed, or vice versâ.*—The slightest consideration of the bulk and strength of the muscles by which the Lower Limbs are moved naturally leads to the presumption that the part upon which they move should be made as strong and as firm as possible, to render their motions effective. It is on this account that the Pelvic bones, which are as truly part of the Lower as the Clavicles and Blade-bones are of the Upper Limbs, instead of being movable like them, or, when immovable, principally fixed by muscles, are firmly connected to each other and to the Spine. But the purpose intended by the immobility of the Basin is not merely to afford a point of resistance whence the muscles moving the Thigh and Leg may act, but also to avoid the necessity of a large mass of muscles which would be requisite to render it sufficiently steady were the Basin movable upon the Trunk like the Shoulder-bones, before the muscles operating on the Thigh and Leg could act. As it is, however, the Basin can be firmly fixed upon the head of one Thigh-bone by those muscles which support the erect posture; whilst the same muscles, acting upon the other Thigh, the foot being first disengaged from the ground, throw the limb forward, and at the same time pointing the toe, lengthen the Leg, so that the foot again touches the ground; and in its turn becoming the point of resistance, the muscles passing between the Lower Limb and the Pelvis act upon, bring it forward and transfer the weight of the Trunk to that Limb which had been but now advanced, leaving the other which had previously supported the body at liberty to be moved forwards. In this manner, at every step, does the Basin become alternately the part from which motion commences and that which is moved; the only change in its position consisting in a little inclination to that side which is to be fixed, whilst the other Limb is slightly raised from the ground prior to its advancement.

Thirdly. *As to the movements of the Spine upon it.*—These are very slight, and confined merely to a little flexion and extension. The Pelvis may also reciprocate this motion upon the Spine, but for this purpose it is necessary that the Trunk should be horizontal.

Fourthly. *Its motions upon itself* are extremely confined, the close junction of the pubic portions with each other, and of the Iliac portions of the Pelvic bones with the Rump-bone, precluding other than a slight yielding, which saves the jarring of the bony ring in all the varieties of motion which are performed upon it. The lower part of the Tail-bone, however, forms an exception, at least in early life, to this unyielding connexion; its last segments are capable of being thrust backwards, and so increasing the size of the outlet under particular circumstances, which is especially seen in parturition.

Fifthly. *As forming a large cavity for the lodgment of important parts.*—In the True Basin are protected part of the Alimentary Canal, and also of the Urinary and Reproductive Organs. The expansions of the Hip-bones in the False Pelvis also give lodgment to important parts of the Large Intestines.

2. The Thigh-bone (*Os Femoris*, Lat.; *die Oberschenkel-bein*, Germ.; *l'Os de la Cuisse*, Fr.) (Pl. IV., fig. 1.).

This, which is the largest bone in the body, has a cylindrical form, but slightly curved forwards; its fore-part (a.) is very smooth, but behind it is pinched up, as it were, to form a prominent ridge or rough line, *linea aspera* (b.), which serves at the same time to support the bowing forward of the shaft of the bone, and to increase the surface for muscular attachment without materially increasing its bulk. At each extremity the bone is much larger than in the middle; at its upper end a strong process rises above its outer edge, which is called the *great trochanter* (c.); and about two inches below this and to the inner side, is a strong rounded process called the *little trochanter* (d.), remarkably developed from giving attachment to the large muscles which bring the Thigh forwards on the Trunk in progression. Extending inwards and upwards from between these two processes, and forming an arc of a large circle, is the *neck* (e.) of the bone, which terminates in a large rounded smooth surface, with its convexity facing upwards and inwards, and having a small irregular pit in it: this is called the *head* (f.), and, being received into the Hip-socket with it, forms the Hip-joint. The lower end of the bone is largely expanded, forming two large processes, the *condyles* (g. h.), of which the *inner* (g.) is the larger and longer; they are separated below and behind by a deep *pit* (i.), are convex from above downwards, and slightly from side to side, so that they are inclined towards each other. Four *joint-surfaces* are found upon them; the *upper* and *anterior* two (j.), of which the outer is the larger for the knee-cap; the *under* and *posterior* (k.), of which the inner is the larger, for the top of the Shin-bone; the latter two occupy by far the greater portion of the lower end of the Thigh-bone, affording surfaces on which the Shin-bone describes full two-fifths of the circumference of a circle.

The position of the Thigh-bone between the Basin

and the Leg is not vertical, but inclining from above downwards and inwards, so as to bring the knees closer together, and consequently near the imaginary line which, passing through the centre of the body, falls between the feet.

Of the Hip-Joint (Anat. Pl. III., fig. xxxvi.; Pl. IV., figs. ii. and iii.).

The deep cup-like cavity of the Acetabulum or Hip-socket, and the head of the Thigh-bone, are connected together by two ligaments, and the former is considerably deepened by an edging of fibro-cartilage, which forms a ring continued from one point to the other of the gap at its inner under part, and this portion is sometimes called the *Transverse Ligament* (Pl. III., fig. xxxvi. j.). From around the circumference of the Acetabulum, the longitudinal fibres of the *Capsular Ligament* (Pl. IV., fig. ii. a.) pass to the Thigh-bone, and, running over its head, are attached in front to a line running between the two trochanters, but behind they reach only to about the middle of the neck of that bone. This ligament is very thick at the fore upper and outer part where the head of the Thigh-bone is least guarded. The *Round Ligament* (fig. iii. b.), as it is improperly called, being nearly flat, originates by a broad expansion from the pit in the bottom of the Hip-socket, and mounting upwards and outwards is firmly connected with the pit in the head of the Thigh-bone. The use of this ligament is to prevent dislocation of the Thigh-bones when the legs are far separated from each other outwards. The joint is a true one, the joint-surfaces being covered with cartilage upon which the synovial membrane is stretched, and thence expanded upon the Round Ligament, and over the interior of the Capsular.

The junction of these bones forms a ball-and-socket-joint, in which the largest extent of motion is permitted; flexion, extension, adduction, abduction, and the succession of these, circumduction, can all be and are constantly performed at the Hip-joint.

In order to prevent frequent repetition, the consideration of the mechanism of this joint, in reference to the support it affords the Trunk, and the motions which in locomotion the Thigh-bone performs upon the Hip-socket, and the reverse, must be deferred till the whole Lower Limbs and their Joints have been described.

3. The Leg (*Crus*, Lat.; *die Unterschenkel*, Germ.; *la Jambe*, Fr.) (Anat. Pl. IV., fig. iv. to vi.)

Consists of three bones, the Shin-bone, Knee-cap, and Splint-bone. Strictly speaking, however, there are only two, as the knee-cap is merely a movable process of the Shin-bone, the analogy to which is found at the elbow-joint in the olecranon process of the Ulna or Cubit, which has the same office and similar position, whilst it forms an integral part of the bone itself.

a. The Shin-bone (*Tibia*, Lat.; *die Schien-bein*, Germ.; *le Tibia*, Fr.) (Figs. iv. and iv.*)

Receives its technical name from its supposed resemblance to the form of an antique flute. It is a large long bone, of prismatic shape, with its base behind and its apex in front; the latter is in common language called the *Shin* (a.), and is visible through the skin, by which alone it as well as the inner surface of the prism is covered, whilst the other two faces are enveloped in muscle. The upper end of the bone, called its head (b. c. d.), is much expanded, specially from side to side, of an oval form, and having two joint-surfaces (c. d.) upon it, each of an oval form, and the inner (c.) the larger, and separated from each other by a short stumpy process (e.), bounded before and behind by a pit; these surfaces are slightly concave, have their long axes from before to behind, and receive upon them the joint-surfaces of the Thigh-bone. On the outer under part of the head is a flattened joint-surface (f.) for the Splint-bone; and below the front of the head is a projection called the tubercle (g.), to which the knee-cap is connected by ligament. The lower end or base (h.) has a joint surface (j.) concave from before to behind for the Astragal; on its outer side is an irregular one for the lower end of the Splint-bone, whilst its inner edge depends considerably, and forms a large process called the inner ankle, *malleolus internus* (k.), which has a joint-surface on its outside for the Astragal, and thus protects in that part the Ankle-joint; behind it is a groove for the passage of one of the flexing tendons into the sole of the foot.

b. The Knee-cap (*Patella*, Lat.; *die Knieschiebe*, Germ.; *la Rotule*, Fr.) (Figs. v. and v.*)

Is really, as before stated, a mere movable process of the Shin-bone, which in some of the Water-Birds is fixed. It is of a triangular shape, with the base uppermost; it has two joint-surfaces (a. b.) behind, of which the inner (a.) is the larger, received on the upper joint-surfaces of the condyles of the Thigh; the bone in front (c.) is rough. Its primary use is to lengthen the lever which by the extending muscles act upon the leg, and so render their action more powerful. Secondarily, it protects the front of the knee-joint from injury, which it does very effectually in whatever position the leg may be placed, in consequence of its ligamentous connexion with the Shin-bone allowing its perfect adaptation to the joint-surfaces of the Thigh-bone.

c. The Splint-Bone (*Fibula*, Lat.; *die Waden-bein*, Germ.; *le Péroné*, Fr.) (Figs. vi. and vi.*).

The Splint-bone is a long thin bone placed on the outer side of the Shin-bone, and marked by several longitudinal sharp ridges and grooves to increase its surface for the attachment of muscles. At the upper and inner part it is connected to the Shin-bone by an oblique flat joint-surface, and from the outside of this springs up a little process called the *bicipital* (a.), which gives attachment to one of the flexing muscles of the leg. At the lower end it is also connected with the outside of the Shin-bone, but its extremity descends below that junction to protect the outer side of the ankle-joint, forming a large process called the outer ankle (b.), *malleolus externus*, which has on its inner side a large triangular joint-surface for the Astragal; and behind it is a groove for the passage into the foot of two of its extending muscles.

The use of this bone, which, excepting at its extremities, is at some distance from the Shin-bone, is first, to make a broad surface for the attachment of muscles, at the same time that it strengthens the Shin-bone by its splint-like connexion with it; secondly, it protects completely the outside of the Ankle-joint.

Of the Knee-joint (Anat. Pl. IV., figs. vii. vii.* viii.).

The Articular surfaces in this joint are eight; a pair on the front of the Condyles of the Thigh-bone to cor-

respond with a pair on the Knee-cap, and a pair on the under and back part of the same processes, which answer to a pair on the head of the Shin-bone; their form and extent have been described above.

The Knee-cap, as already mentioned, being merely a movable process of the Shin-bone, its flexible connexion, the *Ligament of the Patella* (a.), is so strong that it even exceeds the tenacity of bone, as proved by the frequent occurrence of transverse fracture of the Knee-cap by muscular action, whilst the ligament remains uninjured. It is very wide and thick, attached to the tubercle of the Shin-bone below, and rising up vertically begins to be fixed on the apex of the Knee-cap, and thence along its sides and front surface, and becomes confounded with the periosteum.

To the edges of the Knee-cap is also attached the *Capsular Ligament* (b. b.), the fibres of which pass from above the articular surfaces of the Thigh-bone to below those of the Shin-bone, including them in a capsule, into the front of which the Knee-cap is, as it were, let in, strengthening it before, whilst on the sides and back the capsule is strengthened by other ligamentous bands. One, extending from the fore and inner part of the inner condyle, and spreading out in a triangular form as it is attached below the inner side of the head of the Shin-bone, is called the *Internal Lateral Ligament* (c.); another, like a thick cord passing from the outer and back part of the outer condyle, descends to the outside of the head of the Splint-bone, where it it is attached, and is called the *Long External Lateral Ligament* (d.), as a second shorter, broader, but less strong one passes behind it between the same bones, and is called the *Short External Lateral Ligament*. The direction of all these lateral ligaments is rather backwards as well as downwards, so that when the Knee is bent they are slack, but when straight are tense. From the upper and back of the outer condyle originates the *Posterior Ligament* (e.), which, spreading as it passes over the back of the Capsule, is fixed to the back and inner part of the head of the Shin-bone.

All the just described fibrous bands are external to the Capsular ligament, and with the purpose of strengthening it, which they do materially; but both they and it are merely secondary agents in the connexion of the Thigh with the Shin-bone. This is principally effected by a pair of strong cord-like ligaments within the capsule, which, in consequence of their crossing each other, are called *Crucial* (f. g.). The *Anterior* or *External* (f.) is the shorter of the two; it arises from the back and inner surface of the outer condyle, passes forwards and inwards to be fixed in the pit between the front of the articulating surfaces on the top of the Shin-bone; the *Posterior* or *Internal* (g.), commencing from the outside of the inner Condyle by a very wide semilunar root, passes downwards and backwards, and is fixed in the pit between the hinder margins of the articular surfaces on the head of the Shin-bone, and also connected with the little process which separates this from the anterior pit.

The articular surfaces on the head of the Shin-bone which receive the Condyles of the Thigh-bone, are, so far as the bone is concerned, very shallow; but to prevent the Condyles from sliding off when the Knee-joint is bent, at which time all the ligaments except that of the Knee-pan are lax, they are deepened by a pair of *Interarticular Cartilages*, which from their form are called *Semilunar* (h.), and are attached around the head of the Shin-bone, their extremities nearly meeting at the insertion of the Crucial ligaments; their external circumference is about the eighth of an inch deep, but as they extend inwards towards the centre of the joint they gradually diminish in thickness, so that their interior edge is quite sharp; their breadth varies from three-eighths to half an inch, and the outer is the deeper, and its circumference nearly completes a circle; by their outer margins they are connected with the capsular ligament which connects them with the head of the Shin-bone, and they are attached to one another before and behind by *Transverse Ligaments*.

The Knee is a hinge-joint, flexion and extension only being the motions for which it has been specially formed; but when bent all the ligaments are, to a certain extent, relaxed, and a slight rotation between the Thigh-bone and Shin-bone is permitted, which is greatest outwards. On the contrary, when the Knee is straight all the ligaments except the Capsular are quite tense, so that the leg is compelled to follow entirely whatever motions are performed at the Hip-joint.

Junction of the Shin and Splint-bones.

For the purpose of diminishing the weight of the Leg without lessening the surface for muscular attachment, it is composed of two bones connected at their upper and lower ends, and having between them an aponeurosis or fibrous expansion called the *Interosseal Ligament;* improperly, as Cruvelhier has justly remarked, for its use is not to connect the bones, but to provide a surface for the origin of muscles; their only true connexion being above and below. The *upper* junction is a true joint, admitting of no motion beyond a slight sliding, the surfaces being flat and contained within a strong straight Capsular Ligament. The *lower*, on the contrary, is not a true joint; neither bone has an articular surface, and they are immediately connected by a mass of fibro-elastic ligament, which forms but a thin bed between them. This is strengthened by two short bands passing from the fore and back part of the outer edge of the base of the thin bone to corresponding parts on the malleolar process of the Splint-bone, which are called *Anterior* and *Posterior Fibro-Peroneal Ligaments*, of which the latter is the strongest, and descends lower.

4. The Foot (*Pes*, Lat.; *der Fuss*, Germ.; *le Pied*, Fr.) (Anat. Pl. IV., fig. IX. to XVIII.)

Consists of three portions,—the Tarsus, Metatarsus, and Toes: the former two of these compose an arch upon which the whole weight of the body rests; whilst the latter, by clinging to the ground, tend to steady it when the body is at rest in the upright posture, and, when progression is performed, assist in giving the muscles a fixed point of resistance, by which the leg is bent forwards upon the foot, and the first effort at bringing the body forward made.

a. The Tarsus (*Tarsus*, Lat.; *die Fusswurzel*, Germ.; *le Tarse*, Fr.) (Fig. IX. to XVI.).

The Tarsus consists of seven bones of very different form, but, when connected together, making up the hinder half of the Arch of the Foot.

1. The uppermost bone is called the Astragal (*Astragalus*, Lat.; *das Sprung, oder Knöckel-bein*, Germ.;

l'Astragale, Fr.) (figs. IX. a. and X.); in common language it is named the Knuckle-bone; and it is that by which the Foot is connected with the Leg. It has a *convex joint-surface* above (a.) to receive the lower end of the Shin-bone, and on either side a *hollow surface* against which rest the ankles, that for the outer (b.) being the longest. It may be remembered that the ankles extend below the base of the Shin-bone, consequently the Astragal is received between them, and thus a most perfect hinge-joint is produced, so that it is almost impossible to have displacement of this bone from the ankle-joint without fracture of one or both of the ankles. Upon the under surface are two *joint-surfaces* for the Heel-bone, which affect a lengthened shape, and on the fore part is a *rounded joint-surface* (c.) for the Navicular bone.

2. The Heel-bone (*Os Calcis, seu Calcaneum*, Lat.; *das Fersen-bein*, Germ.; *le Calcaneum*, Fr.) (Fig. IX. b. XI.) is the largest of all the Tarsal bones, and of an irregularly rhomboidal figure. It is nearly flat on the outer side, but on the inner side has a deep hollow called the *sinuosity*, formed by the overhanging of the *inner* (b.) of the two *joint-surfaces* (a. b.) on its upper surface for the Astragal. Through this hollow the flexing tendons, the muscles, vessels, and nerves, pass into the sole of the foot, and are protected from pressure. On the front of the bone is an irregularly *plain surface* (c.) for its junction with the Cuboid bone; but the most remarkable point in it is the *tuberosity* (d.), a large protuberance extending considerably behind the Ankle-joint, and in common language called the *heel*. This, whilst increasing the expanse of the sole, and thereby rendering the base of support for the body more steady, also affords a powerful lever, by means of which the extending muscles are able to raise the hind part of the foot; and if it be fixed by the toes grasping the ground, it elevates the body upon the foot. It is also well worthy of notice, that man is the only animal in which the heel touches the ground, and it therefore forms one of his generic characters.

The four following bones compose that part of the Arch of the Foot commonly known as the *Instep*:—

3. The Navicular bone (*Os Naviculare, seu Scaphoideum*, Lat.; *das Kahn-bein*, Germ.; *le Scafoide*, Fr.) (Fig. IX., c. XII.), so called from its resemblance to a coracle or skin boat, is placed in front of the Astragal. Its hinder end (b.) has a large *cup-like joint-surface*, into which it receives the rounded head of that bone, in consequence of which greater motion is performed between these two than any other bones of the foot. Its front (a.) is slightly convex, and received into a similar, but more shallow cup, formed by the Cuneiform bones; and upon its inner under surface is a *stout knob*, to which a large tendon is attached.

4, 5, 6. The Cuneiform bones (*Ossa Cuneiformia, seu Sphenoidea Tarsi*, Lat.; *die Keil-beine*, Germ.; *les Os Cunéiformes*, Fr.) (Figs. g. d. e. f., XIII., XIV., and XV.) are wedge-shaped, the inner having its *base* below, and the outer two above. The inner (fig. XIII.) is the largest; the middle (fig. XIV.), the shortest and smallest; and the outer (fig. XV.), of intermediate size. As they are all placed side by side, they have *joint-surfaces* connecting them with each other; but the outer has a large *joint-surface* on its outside for the Cuboid bone, and the inner a *knob* on its inside for the attachment of a tendon. Their hinder ends have *joint-surfaces*, which together form a shallow cup for the Navicular; but in front, consequent upon the shortness of the middle bone, a mortise is left which receives the hinder extremity of the second Metatarsal bone, which is further connected by corresponding joint-surfaces on the inner and outer Cuneiform-bones.

7. The Cuboid bone (*Os Cuboideum*, Lat.; *das Würfel-bein*, Germ.; *le Cuboide*, Fr.) (Figs. IX. g. XVI.) resembles a flattened cube, is placed in the same rank as the Cuneiform bones, but on their outer side. Its hinder *joint-surface* connects it with the Heel-bone, but before it does not extend so far forward as the outer Cuneiform bone, which in its turn forms the tenon mortising with the Metatarsal bones. Its under surface is *grooved* deeply for the passage of an important tendon, which assists materially in supporting the transverse arch of the foot.

b. The Metatarsus (*Metatarsus*, Lat.; *der Mittelfuss*, Germ.; *le Metatarse*, Fr.) (Fig. IX. h. h. XVII.) is placed between the last row of the Tarsal bones and the roots of the Toes, which it supports. It consists of five bones of an irregularly cylindrical form, with a slight compression. Their hinder ends or *bases* (d.) have flattened joint-surfaces which connect them with the Cuneiform and Cuboid bones, whilst their front extremities or *heads* (e.) are rounded to receive upon them the first row of the Toe-bones. Three of them are distinguished from the others: the *first* (a.), which supports the Great Toe, by its shortness and thickness; the *second* (b.), by its great length and slenderness; and the *fifth* (c.), which joins the Little Toe, by a protuberance which projects beyond the outer edge of its tarsal joint-surface. They are firmly connected with the Tarsal bones by dove-tail or double mortise and tenon. The lengthening of the second bone forms the tenon received into the mortise of the Cuneiform bones; whilst the third, or middle bone, being shorter than either of the others beside it, leaves a second though shallow mortise in the opposite direction to that just mentioned, into which the front end of the outer Cuneiform bone is locked.

c. The Toes (*Phalanges digitorum Pedis*, Lat.; *die Zehenglieder*, Germ.; *les Orteils*, Fr.) (Fig. IX. i. i. XVIII.) consist of fourteen bones, disposed in three rows (b. c.), *phalanges*, excepting that of the Great Toe (a.), which anatomically is called the Foot Thumb, *pollex pedis*, as it really is in some Beasts, and in the whole Class of Birds, and has but two rows. The bones belonging to it are, however, of greater size than the others; indeed, equals them altogether. This remarkable bulk, at the expense of the others, indicates the greater importance of this member of the foot, upon which, indeed, at every step, the whole weight of the body is received. The general form of the first two rows is similar, except in their hinder ends or *bases*; those of the first row being cup-like, to receive the rounded heads of the Metatarsal bones; whilst the bases of the second and third rows are composed each of a slight concavity, with a middle ridge corresponding to the *heads* of the row immediately behind them, which are of a semicircular form, with a middle depression. The front ends of the third row are distinguished from those of the other two in not having any joint-surfaces, but becoming thin and expanded to support the nails.

Of the Ankle-Joint (Fig. XIX. XIX.*).

The bones composing this joint are the Shin and Splint bones above and on the sides, and the Astragal

below. Like the knee, it is a true and a hinge joint; but, in order to prevent the possibility of lateral displacement, the base of the Shin-bone sends down the process called the Inner Ankle, and the Splint-bone that called the Outer Ankle, which completely lock in the Astragal on the sides.

The six articular surfaces of these bones are included in one common loose *Capsular Ligament* attached around their margins. This is strengthened by ligamentous cords passing from the Outer Ankle to the Tarsal bones by one broad band from the Inner Ankle to the Tarsus also.

Of the three *Peroneo-tarsal Ligaments* the *anterior* (a.) is the shortest; it passes from the front of the malleolar or ankle process to the fore and outer part of the Astragal; the *posterior*, which is the strongest, passes from the back of the same process obliquely inwards to the inner back part of the latter bone; and the *exterior* (b.), called also *perpendicular*, descending vertically from the point of the Outer Ankle, is fixed in the outside of the Heel-bone.

The inner, or *Tibio-Tarsal Ligament*, named also from its form *Deltoid* (c.), originates broadly from the lower edge of the Inner Ankle, spreads out as it descends, and is attached at first to the Astragal below by its base to the upper edge of the sinuosity of the Heel-bone, and by its front angle with the inside of the Navicular bone. It thus not only connects the Leg to the Foot, but strengthens the two hinder Tarsal joints at their inner edge where they are weakest.

Flexion and extension are the special motions of this joint, but when the foot is extended upon the leg there is a slight degree of lateral motion.

Junction of the Tarsal Bones.

The Tarsal bones are connected to each other by *Capsular Ligaments*, strengthened by short flat ligamentous bands, which spread out in different directions; they are named from their situation upon the upper surface of the Foot, *Dorsal*, and upon the under *Plantar*: of these the latter are strongest on account of having to maintain the Tarsal Arch, and two of them require especial notice. The *Great Inner Plantar* or *Calcaneo-navicular Ligament* (fig. XIX.* d.) extends from the whole under surface of the anterior Astragalar articular surface of the Heel-bone to the under surface and tubercle of the Navicular, and completes the bottom of the large cup into which the rounded head of the Astragal is received; and to which a considerable portion of the weight of the body is transmitted. The *Great Outer Plantar* or *Calcaneo-cuboidal Ligament* passes from the fore and under part of the Heel-bone, to which it is broadly attached, forwards to the under part of the Cuboid bone, upon the whole of which it is spread out as far as the hinder edge of its transverse groove. This is the strongest of all the Plantar Ligaments, and materially supports the outer arch of the Tarsus.

All these Joints, with one exception, are formed by flat surfaces which allow merely a sliding motion upon each other; this is greatest between the Astragal and Heel-bone, where the articular surfaces, though flat, are convex from side to side—the convexity of the hinder one facing upwards, and of the front one downwards. The exception is in the ball-and-socket-joint of the Astragal, Heel, and Navicular bones, in which there is very considerable rotatory motion, especially inwards, so that the Sole of the Foot can be made to face nearly directly inwards, its outer edge only resting on the ground. Slight flexion and extension of the fore part of the foot is also performed at this joint; but these are the most restricted motions.

Junction of the Tarsal and Metatarsal Bones, and of the latter with each other.

The Cuneiform and Cuboid bones are connected by flat surfaces, admitting of a little motion, to the bases of the Metatarsal bones, which are strengthened by short Dorsal and Plantar Ligaments; of the latter, that between the Inner Cuneiform and the First Metatarsal, and that between the Cuboid and last or Outer Metatarsal, are the broadest and strongest, as they complete the sustentation of the Tarsal Arch from before to behind. But there is another contrivance by which the Tarsus and Metatarsus are connected, viz., by the mortise and tenon of the Cuneiform and Second Metatarsal bones; *capsular* ligaments connect the sides of the tenon of the latter with those of the mortise of the former, and the tenon is prevented splaying open the mortise below by a strong *oblique ligament*, which, arising from the outside of the Inner Cuneiform, passes beneath the base of the Metatarsal bone, is connected with it, and continued outwards and forwards to be joined to the under and fore part of the Outer Cuneiform and the base of the Third Metatarsal. The Outer Cuneiform bone extending further forwards than the base of the second, and considerably before that of Fourth Metatarsal, forms a second tenon in the opposite direction to that just described, and is received between the mortise formed by those Metatarsal bones; it has no oblique ligament, but rests upon a long ligamentous band, the *Cuboido-metatarsal Ligament*, which, arising from the back and under part of the Cuboid, passes below its groove, and is attached to the outer Cuneiform and the bases of the third and fourth Metatarsal bones.

The bases of the Metatarsus are connected by plane surfaces and *Capsular Ligaments*, and strengthened below by *Plantar* bands, which pass from the base of one to the other.

Junction of the Metatarsal Bones and Toes, and of the Phalanges of the latter.

These are all hinge or rather pulley joints; each is included in a *Capsular Ligament*, strengthened on each side by a short band passing from one bone to the other, and called *Inner and Outer Lateral Ligaments*. All the Metatarso-phalangeal joints are also connected by a *Transverse ligament*, which, passing from the outer edge of the fifth runs beneath the Capsular ligaments of all except the first Metatarsal to the outer Sesamoid bone of which it is attached. Flexion, extension, and lateral inclination can be performed in all this row of joints, though the latter is much restricted by our habit of wearing shoes; but in the remaining joints flexion and extension are the only motions.

B.—Of the Upper Limbs, or passive Prehensile Organs.

Extremitates Superiores, Lat.; *die Oberen Extremitäten, oder Brustglieder*, Germ.; *les Membres Supérieurs*, Fr. (Anat. Pl. IV., fig. XX to XXXVII.)

The Upper Limbs consist of the Shoulder, Upper Arm, Fore Arm, and Hand-bones, and are distinguished from the Lower by the smaller size and more

delicate form which their more movable functions require.

1. The Shoulder or Shoulder Girdle (*Ossa Humeri*, Lat.; *die Schulterknocken*, Germ.; *les Os de l'Epaule*, Fr.)

Consist on either side of two bones, the Collar-bone and the Blade-bone, which join together at an angle, strictly called the Shoulder; whilst by the former only they have a jointed connexion with the Trunk.

a. The Collar-bone or Clavicle (*Clavicula*, Lat.; *die Schlussel-bein*, Germ.; *la Clavicule*, Fr.) (Fig. xx.)

Is placed horizontally at the bottom of the Neck, which it separates from the Chest, having at its inner end the Breast-bone, and at its outer the Blade bone. It assumes its technical name from its resemblance to an antique key, being similar to an Italic *ʃ* placed horizontally; its inner extremity (a.) is large, irregularly rounded, and has upon it a *flattened articular surface*, by which it is connected with the Breast-bone; upon its under surface, and about an inch from this extremity, is a rough surface called the *rhomboid process;* the *body* (c.) of the bone, or all that part between its ends, is rounded above, flattened beneath, at first curves forwards from the inner extremity, then backwards and again forwards at the outer end, which is much flattened from above downwards, expanded from before to behind, has about an inch from its tip, on the under surface, a projection called the *tubercle* (d.), and upon its extreme outer and back part a small *flat articular surface* for the Blade-bone.

b. The Shoulder-blade (*Scapula*, Lat.; *das Schulterblatt*, Germ.; *l'Omoplate*, Fr.) (Fig. xxi., xxi.*, xxi.**)

Is placed at the hinder upper part of the Chest, which, by its large expansion, it covers like a shield, where least capable of other protection.

It is a thin expanded bone, of an irregular triangular form; the *base* (a. b. c.) parallel to the ridge of the Spine of the back, and the other two *edges*, named from their position, *upper* (b. l.) and *lower* (c. d.); the former nearly horizontal and the latter diagonal; the upper (b.) and lower (c.) extremities of the base are called the *upper* and *lower angles*, and the junction of the upper and lower edges the *outer angle* (d.), which is the most important of the three, as having upon it a large shallow oval articular surface, the *glenoid cavity* (d.), facing outwards; the long axis of which is from above to below, and receives upon it the head of the Upper Arm-bone; immediately to the inner side of this cavity a contraction of the bone forms its *neck* (e.), and from its fore and upper part a strong process somewhat resembling a crow's beak, and hence called the *coracoid process* (f.), curves forwards and outwards beyond the articular surface so as to protect it in front. The fore surface of the bone, called its *belly* (g.), is slightly hollowed and marked by muscular ridges; the hind surface or back is correspondently convex, and divided into *two unequal pits* by a strong projecting process called the *spine* (h.), which commences from the base about an inch below its upper angle, increases in depth as it ascends towards the neck, where its connexion with the body of the bone ceases, but it continues outwards curving over the top of the glenoid cavity, and expanded horizontally to form a large flat process called the point of the Shoulder or *acromion* (i.), on the front of which is a small articular surface for the Collar-bone. Of the two pits formed by the upraised spine, the upper (j.) is the *supra-spinal*, and the lower (k.) is the *infra-spinal pit*. At the root of the coracoid process, and in the upper edge, is a small *notch* (l.) for the transmission of an artery, and the space between the upper edge of the glenoid cavity and the root of the acromion, which serves the same purpose, is described as a second *notch*.

Of the Joints of the Shoulder-bones.

These consist of two, the *first* by which the Collar-bones are connected to the Chest and to each other, the *second* between the Collar and Blade bones; the latter of which, by this junction, are linked on to the Trunk.

1st. The *Sterno-clavicular Joint*.—The inner or sternal end of the Collar-bone, of which the articular surface is nearly flat, is connected with the concave surface at the upper corner of the first piece of the Breast-bone by means of a ligamentous capsule, the interior of which is divided into two distinct cavities lined with synovial membrane, and therefore true joints, by a *cartilage* called, from its situation, *Inter-articular*, and hollowed on both sides, an articular structure always existing where great extent and variety of motion is performed. This joint is further strengthened by some fibrous bands called the *Inter-clavicular ligament*, which, passing across the top of the Breast-bone, and connected with it, spread out on either side upon the inner ends of the two Collar-bones, the under surfaces of which are also tied to the first pair of Ribs by a pair of ligaments called the *Rhomboid* or *Costo-clavicular*, which pass from those bones to the rhomboid processes.

2nd. The *Acromio-clavicular Joint*, formed by the junction of the outer or Scapular end of the Clavicle with the Acromion by the articular surfaces already mentioned, is sometimes a true joint with cartilage covering those surfaces, included in a ligamentous capsule, and lined with synovial membrane; but more frequently the two bones are merely connected by a ligamento-cartilaginous structure, which is sufficient for the purpose, as there is no motion beyond a slight yielding between them. The connexion of these bones is further strengthened by two short strong ligamentous bands springing from the root of the Coracoid process, and named according to their connexion *Coraco-clavicular*, or in relation to their form, the anterior, the *Trapezoid*, and the posterior, the *Conoid*.

There are also some ligaments proper to the Blade-bone itself: the principal of these is a very broad and strong triangular one, which, springing from the whole upper surface of the coracoid process, passes outwards and upwards to be attached to the fore under and outer part of the acromion; its use is to protect the front of the shoulder-joint, which it does very efficiently; it is called from its form *Triangular*, or from the parts which it connects *Coraco-Acromial*. From the root of the coracoid process passes inwards across the notch in the upper edge of the Blade-bone a narrow band of stout ligamentous fibres, which render it a perfect hole; and there is often described as running from the root of the acromion to the upper edge of the glenoid cavity, another, the *Acromio-Glenoid Ligament*, the assumed use of which is to brace up that part of the bone; it is not, however, really ligamentous, but merely a small quantity of cellular tissue, beneath which passes a

branch of the Subscapular artery, and is not of sufficient strength to afford any support to the glenoid cavity.

The junction of the Collar and Blade bones with each other, and of the former with the Breast-bone, has some analogy to the bony ring of the pelvis, the Breast and Collar bones corresponding to the Pubic portion, and the Blade-bones to the Iliac portion; but it differs in being imperfect behind, and in not being connected with the Spine except by muscle: the reason for which is, that in the Shoulder motion is required, in the Basin solidity and strength.

The apparatus for Motion at the Shoulder, so far as it is at present to be considered, relates to keeping the Socket of the Shoulder-joint at such distance from the Trunk that the motions of the Arm upon it may not be interfered with. For this purpose is the Collar-bone formed and interposed between the Breast and Blade bone; and though it is capable of performing elevation, depression, and horizontal motion forwards and backwards upon the Breast-bone, yet however powerful the muscular action, the glenoid cavity can never be drawn so near to the Chest as to interfere with the motions of the Arm. Without the Clavicle to keep it off, the Blade-bone would, instead of being situated upon the back of the Chest, as it is in all animals which have a Clavicle, rest against the side of the Chest, and the Arm could not be carried across the body and raised to the mouth, nor could it be abducted or raised from the side of the Trunk: its motions would be confined simply to swinging backwards and forwards, as they are in all those Animals in which this bone is deficient, and in which the Fore Limbs, as the upper are then called, are mere progressors upon the ground. But when these Limbs are partially locomotive and partially prehensile, there always exists a Collar-bone more or less fully developed according to the variety and power of the prehensile actions, of which ample examples are given in the Essay on ZOOLOGY.

2. THE UPPER ARM (*Brachium*, Lat.; *die Oberarm*, Germ.; *le Bras*, Fr.) (Fig. XXII.)

Consists of a single bone.

The Upper Arm-bone (*Os Brachii*, Lat.; *die Oberarmbein*, Germ.; *l' Humerus*, Fr.).

This depends from the Glenoid cavity upon the side of the Chest, and extends between the Shoulder and Elbow Joints.

It is of an irregularly twisted cylindrical shape; its upper end has a large rounded articular surface facing upwards, inwards, and rather backwards, forming a considerable portion of a sphere, and called the *head* (a.), to the outer and fore part of which are two knobs (b. c.), separated from each other by a *groove* for the passage of a tendon, and called *tubercles*, of which the outer is the larger; just below these, a contraction of the circumference of the bone is called its *neck* (d.), and thence to the lower end the shaft, which is of a somewhat triangular and twisted form, is called the *body* (e.), marked on the outer upper part by a rough surface for muscular attachment, and by the continuance of the groove which had commenced between the tubercles, bounded by two ridges. The lower end of the bone expands laterally, is nearly flat behind and rounded laterally in front, and is terminated below by two lateral projections called *condyles* (f. g.), of which the inner (f.) is most developed, and has behind it a vertical pit for the passage of a nerve; between the condyles is a *double pulley-like articular surface* (i.): the *outer* portion of this surface is nearly hemispherical and the smaller of the two, but the *inner* is convex from before to behind, and concave from side to side, with a shallow pit above it before and a deep one behind.

Of the Shoulder-Joint.

The Shoulder-Joint is, next to the Hip, the most perfect ball-and-socket-joint in the body, but differs from it in its shallowness, which allows greater extent and complication of motion. The rounded head of the Upper Arm-bone rests upon the shallow glenoid cavity, which is deepened by a circular ligamentous ring at its margin, called the *Glenoid Ligament*, around which extends from the neck of the Blade-bone, over the head of the Upper Arm-bone, a very loose ligamentous bag, called the *capsular ligament* (b.), which, however, does not bring the bony surfaces into immediate contact: this is effected by means of one of the tendons (c.) of the Biceps flexor cubiti-muscle, which, originating from the upper edge of the glenoid cavity, passes over the head of the Arm-bone, and through the Capsular ligament between the tubercles to join its muscular part; but it is external to the joint even whilst within the capsule, the synovial membrane which lines the capsular ligament and covers the articular cartilaginous surfaces of the bones being reflected on it. This tendon corresponds in function to the round ligament of the hip-joint, but in consequence of the greater length of the capsular ligament, a large extent and greater freedom of action is allowed in this joint than could be admitted were the two ends of the connecting tendon permanently fixed, as are those of the round ligament of the hip. No loss of strength, however, accrues from this formation; for in proportion as the hand is weighted this muscle in endeavouring to raise it acts from both its extremities, and whilst thus operating on the Fore Arm approximates the head of the Upper Arm-bone more closely to the glenoid cavity, and strengthens the joint. Another ligament of the Shoulder-Joint, the *Coraco-Acromial* (a.), belongs only to the scapula, passing from its coracoid to its acromial process; but it is of great importance as protecting and strengthening the front of the Shoulder-Joint, so that the head of the Arm-bone cannot be driven upwards and forwards out of the shallow socket.

The Shoulder-joint is protected from injury above by the acromion, which almost completely overhangs it, and in front by the coracoid process; so that it is only exposed on the outer and back part, where, however, it is defended by the large mass of muscles covering it and moving the Arm, the tendinous expansions of some of which are intimately blended with and strengthen the ligamentous capsule itself.

The motions performed at the Shoulder-joint consist of procession and retrocession, and their successive alternations, a swinging motion; also of abduction and adduction, or elevation and depression; a rotatory motion when all these four movements are successive, the elbow-joint describing the periphery of a large circle, whilst the head of the Upper Arm-bone moves only upon the glenoid cavity, with little actual change of position, just as a stone attached to a string held in the hand and whirled round moves. When the Arm is upheld

in the horizontal posture, the elbow and fore arm can be brought forward or carried backwards. And when it hangs to the side, a rotatory motion upon the glenoid cavity, similar to that of a spindle, can be performed. From this enumeration it will be easily imagined that the capability of motion at this joint is very great, and the possible combinations of motion almost innumerable.

The ordinary movements of the Arm are performed on the Glenoid cavity, as the fixed point; but when more violent exertion is required, as in pulling, throwing, striking, &c., the whole Shoulder, *i.e.*, the Collar and Blade bone, participate in the motion by the swinging of the sternal end of the Clavicle upon the sterno-clavicular articulation.

3. The Fore Arm (*Antibrachium*, Lat.; *die Vorderarm*, Germ.; *l'Avant-bras*, Fr.) (Figs. XXIII. XXIV.)

Is all that part of the Upper Extremity between the Elbow and Wrist Joints; it consists of two bones.

a. The Cubit (*Ulna*, Lat.; *die Ellenbogenrohre*, Germ.; *le Cubitus*, Fr.) (Fig. XXIII.)

Is placed on the inner side of the Fore Arm, which it specially connects with the Upper. It is of an irregular triangular shape, except at its lower part, which is rounded; the upper end is the larger, and has on its fore and top part a large semicircular articular cavity called the *sigmoid* (a.), divided by a middle vertical *ridge*, and corresponding to the inner pulley-like articular surface of the Upper Arm-bone, into which it fits; this is bounded above by a strong process, called the *olecranon* (b.), or point of the Elbow which projects backwards when the Fore Arm is bent, but drops into the deep cavity behind the pulley-like surface of the upper bone when straightened; on its back is a smooth surface called the *ancon*, or true elbow; below, the cavity is bounded by the *coronoid process* (c.), which is merely its prominent lip; on the outer side of this cavity is another smaller one, semilunar and horizontal, called the *lesser sigmoid* (e.), in which is received the side of the head of the Spoke-bone; below the coronoid is a rough surface called the *tubercle;* the *body* or shaft (f.) of the bone is nearly prismatic, the base facing inwards, and its angles rounded, the apex outwards, sharp and thin, for ligamentous attachment; the lower end or *base* (h.) has a *rounded articular surface* (g.) on its outer and fore part for the Spoke-bone, and is elongated on the inner and under part by a little stud called the *styloid process* (i.).

b. The Spoke-bone (*Radius*, Lat.; *die Speiche*, Germ.; *le Radius*, Fr.) (Fig. XXIV.)

Is situated on the outer side of the Fore Arm, extending between the Elbow and Wrist Joints. Its general form resembles that of a wheel spoke, whence it derives its name. It is of a prismatic figure, smaller and of more rounded form above than below; its top or *head* (a.) is rounded, and has upon it a *cup-like articular surface* for the reception of the outer articular surface of the Upper Arm-bone; around its inner and fore part is a *narrow smooth articular surface*, which is received into the lesser sigmoid cavity of the Cubit; below it a contraction of the bone forms its *neck*, beneath which, on the fore and inner part, is the *tubercle* (b.). The shaft or *body* (c.) of the Spoke-bone increases in bulk as it descends, the base of the prism facing outwards with its angles rounded, whilst the third angle is sharp for ligamentous attachment. The lower end of the bone is very wide, and called its *base* (d.); it has an *articular surface* below, concave from before to behind, divided by a middle ridge, and concave from side to side for the reception of the outer two upper Carpal bones; upon its outer edge it is slightly elongated, forming its *styloid process* (e.); upon the inside of the base is a shallow *semilunar cavity*, by which it rolls upon the lower end of the Cubit; the front of the base is smooth, but its outer and back part marked by *vertical grooves* for the passage of tendons.

Of the Elbow-Joint. (Fig. XXV.)

The Upper Arm-bone, with the Cubit and Spoke bone, form this joint; all their articular surfaces, covered with cartilage, are enveloped in a synovial bag, which is strengthened by ligamentous bands passing in various directions from the Upper to the Fore Arm; these, according to their position, are called *Anterior* (a.) and *Posterior Ligaments*, but more commonly considered as a single one, and named *Capsular;* it is strongest in front and weakest behind, where it is strengthened by the large Extensor Muscle of the arm. On each side of the joint a ligament passes from the condyle to the Cubit on the inner, and to the Spoke-bone on the outer side; the former, the *Internal Lateral* (b.), is of a triangular shape, narrow above and wide below, where connected with the inner edge of the great sigmoid cavity; the latter is narrow and cord-like, the *Outer Lateral* (c.), and attached to the coronary ligament of the Spoke-bone.

The junction of these bones with that of the Upper Arm form merely a simple hinge-joint, flexion and extension being the only motions of which the Cubit (which, with the Upper Arm-bone, truly forms the Elbow-Joint) is capable; for when the Fore Arm is bent the coronoid process of the Cubit is received into the pit above and before the condyles; and when straightened, the olecranon process of the former locks into the deep pit above and behind the condyles.

Of the Fore Arm-Joints. (Figs. XXV. XXVI.)

As already stated, the Fore Arm consists of two bones, the Cubit and Spoke bone, which, however, although connected so as to form only a single limb, yet present some remarkable points in their junction, arising out of the necessity for the motion of one bone upon the other, so as to allow certain motions of the Hand.

So far as their junction with each other is concerned, they are united by an expansion of ligamentous fibres passing from the outer angle of the Cubit to the inner angle of the Spoke bone, throughout their whole length, which is called the *Interosseous Ligament;* one aperture is left at the upper, and another at the lower part of this ligament, for the passage of vessels and nerves; and a narrow slip of it at the upper part, which passes from the tubercle of the Cubit to the lower part of the tubercle of the Spoke bone, is called the *Oblique Ligament* (d.). By these the two bones are so firmly connected, that for actual use they may be considered as a single bone.

The mechanism by which the Spoke-bone moves round the base of the Cubit to perform pronation and supination of the Hand, consists in a ligamentous collar, which is called the *Coronary Ligament* (e.), sur-

rounding the neck of the Spoke-bone, and attached immediately beneath the less sigmoid cavity of the Cubit, confining the head of the Spoke-bone in that cavity, and therefore compelling it to perform only a rotatory motion, like that of a pivot in its socket. The lower end of the Spoke-bone is, however, very differently circumstanced, as it travels round the base of the Cubit describing a semicircle; this is effected by the concavity and convexity being reversed; at the upper end the concavity is on the Cubit, and the convexity on the Spoke bone, but at the lower end the latter is concave and the former convex; the lower end of the Cubit is enveloped in a loose, bag-like ligament, hence called the *Sacciform Ligament*, which includes the concavity on the inside of the base of the Spoke-bone, and is attached below to an irregularly circular cartilage, called the *Inter-articular*, from being interposed between the Cubit and the Wrist-joint, and attached to the inner edge of the base of the Spoke-bone. In consequence of this disposition of the articular surfaces, and the mode in which the bones are connected by a ligament at their two extremities, any rotation of the head of the Spoke-bone, in the less sigmoid cavity, causes correspondent circumduction of its base upon the base of the Cubit; and as the band is specially connected with the Spoke-bone, as will be presently shown, it is rendered prone by the rotation inwards of the head of that bone, and supine by its rotation outwards, whilst the extent of these motions, in either case, is bounded by the oblique ligament which acts as a check. It is also to be observed that these motions, viz., pronation and supination of the Hand, can be performed, in whatever state of flexion the Fore Arm is, upon the Upper Arm, in consequence of the cup of the Spoke-bone always retaining the same position in regard to the upper end of the Cubit. The common and natural position of the Fore Arm, when hanging down and relaxed, is intermediate between pronation and supination, the styloid process of the Spoke-bone being directed forwards, but in Anatomical description the Fore Arm is always considered supine, and the palm of the Hand consequently facing forwards.

4. The Hand (*Manus*, Lat.; *die Hand*, Germ; *le Main*, Fr.) (Fig. XXVII. to XXXVII.)

The Hand is placed below the Fore Arm, especially connected with the Spoke-bone, and consists of the Wrist, the Mid-hand, and the Fingers.

a. The Wrist, or Carpal Bones (*Ossa Carpi, seu Carpus*, Lat.; *die Handwurzel*. Germ.; *le Carpe*, Fr.) (Figs. XXVII. to XXXIV.),

Consists of eight small bones disposed in two rows, together forming an arch, the span of which is lateral, its concavity forwards and its convexity backwards. Their fore and hind surfaces are generally rough, but their sides and ends form smooth articular surfaces. In form they vary considerably from each other, and are named accordingly. Six of them have four articular surfaces, another six, and the remaining one a single articular surface.

In the first, or upper row, commencing from the outer, they are thus ranged:—

1. The Scaphoid Bone (*Os Scaphoides*, Lat.; *das Schiff, oder Kahn-bein*, Germ.; *le Scaphoïde*, Fr.) (Fig. XXVII.).

In shape this resembles a boat, the convexity or bottom of which faces upwards and outwards. Upon the outside and above, is a large convex articular surface for the Spoke-bone, and below another for the outer two Carpal bones of the second row; above and on the inner side is a semilunar flat surface for the Lunar bone, and below it a concave surface, forming part of the socket for the head of the Great Bone.

2. The Lunar Bone (*Os Lunare*, Lat.; *das Mond-bein*, Germ.; *le Semi-lunaire*. Fr.) (Fig. XXVIII.),

Placed to the inner side of the preceding; of a semilunar form, with its convexity upwards. On its upper part it has a large convex surface for the Spoke-bone; below, a concave one to complete the cup for the head of the Great Bone, on the outside a semilunar one for the Scaphoid, and on the inner a squarish one for the Cuneiform Bone.

3. The Cuneiform Bone (*Os Cuneiforme, seu Triquetrum*. Lat.; *das Dreieckige, oder Dreisitige-bein*, Germ.; *le Pyramidal*, Fr.) (Fig. XXIX.)

Is the innermost of the first row, and of an irregular wedge-shape, with its base connected to the last described bone. The upper end has an articular surface, scarcely deserving that name, by which it joins the inter-articular cartilage; below, it has an articular surface for the Unciform; on the outer side or base, one for the Lunar, and in front another for the Pisiform.

4. The Pisiform or Pea-bone (*Os Pisiforme*, Lat.; *das Erbsen-bein*, Germ.; *le Pisiforme*, Fr.) (Fig. XXX.)

Is placed on the front of the last bone, and in appearance resembles a split pea, the diametral surface of which being its only articular one, is for the Cuneiform.

In the second row there are also four bones, viz.—

5. The Trapezial Bone (*Os Trapezium, seu Multangulum Majus*, Lat.; *das Grosse Vieleckige-bein*, Germ.; *le Trapèze*, Fr.) (Fig. XXXI.),

Which is the outermost, and of an irregular trapezial figure, and it has in front a vertical groove for the passage of a tendon. At the top it has a slightly concave articular surface for the Scaphoid; below, a small one for part of the Metacarpal bone of the Fore Finger; on the outer side, a large articular surface, concave from above downwards, and convex from before to behind, for the Metacarpal bone of the Thumb, and on the inside a nearly flat surface for the Trapezoid Bone.

6. The Trapezoid Bone (*Os Trapezoides, seu Multangulum Minus*, Lat.; *das Kleine Vieleckige-bein*, Germ.; *le Trapèzoide*, Fr.) (Fig. XXIII.),

Placed on the inside of the preceding, resembling a truncated square nail, the head of which faces backwards. It has a slightly concave articular surface above for the Scaphoid; below, another for the Metacarpal bone of the Fore Finger; one on the outer side for the Trapezial, and another on the inner side for the Great Bone.

7. The Great Bone (*Os Magnum, seu Capitatum*, Lat.; *das Grosse, oder Kopf-bein*, Germ.; *le Grand Os*, Fr.) (Fig. XXXIII.)

Placed to the inner side of the preceding, and the

 largest of the Wrist bones, is of an irregular wedge shape, with its base behind, and having on its upper end a large rounded *head.* It has six articular surfaces: above, one, the head, which is received into the cup of the Scaphoid and Lunar Bones; below, three, the middle one the largest, for the Middle Metacarpal; the outer the smallest, to join with the fore Metacarpal, and the innermost rests upon the Ring Metacarpal bone; upon the outside there is a plane one for the Trapezoid, and on the inside a similar one for the Unciform Bone.

8. The Unciform Bone (*Os Unciforme, seu Hamatum*, Lat.; *das Haken-bein*, Germ.; *l'Os Crochu, ou Unciforme*, Fr.) (Fig. XXXIV.)

Is the innermost of the second row, and distinguished by the *hook-like projection* which stands forward from the inner and fore parts of the bone. Its upper end slopes downwards, and is connected with the Cuneiform; its lower end has two articular surfaces, divided by a middle ridge, for part of the Ring and for the whole of the Little Metacarpal Bone, and on its outside is a flat surface for the Great Bone.

The articular surfaces just described as belonging to the several Carpal Bones indicate their junctions, and being generally flat admit of little more than a gliding motion upon each, not excepting even the ball-and-socket-joint formed by the Great, the Scaphoid, and Lunar Bones, which does not appear intended for motion, but rather as the means of connecting more perfectly the two rows of the Wrist-bones, and preventing their dislocation horizontally from each other.

Together they form an arch, the concavity of which is directed forwards, and through which the flexor tendons of the fingers pass into the hand; and when the wrist is rested on a table with the palm downwards, the bases of the piers on which it stands are, on the outer side, the Scaphoid and Trapezial, and on the inner the Pisiform and Unciform Bones.

Of the Wrist-Joint.

The Wrist-Joint is one of those which are called Ball-and-socket-joints, the socket being formed by the base of the Spoke-bone and the under surface of the inter-articular cartilage already mentioned (p. 406), and the ball by the Scaphoid, Lunar, and part of the Cuneiform Bone; the latter is not, however, the segment of a sphere, but of an ellipsis, the long axis of which is from side to side; the socket is very shallow, and corresponds to the ball or ellipsis. The Carpus, taken as a whole, is connected to the Spoke-bone and to the inter-articular cartilage by very strong ligamentous bands, called the *Anterior* and *Posterior* or *Capsular Ligament* of the Wrist, which pass especially from the Spoke-bone to the upper row of the Carpus; and these are of sufficient length to allow the Hand to be flexed upon the Fore Arm to a right angle, and to be extended upon it almost to the same extent. In addition to these, there is on each side a strong ligamentous cord passing between them; that on the outer side, extending from the styloid process of the Spoke-bone to the Scaphoid, is called the *Outer Lateral* or *Radio-Carpal Ligament;* and that on the inside, from the styloid process of the Cubit to the Cuneiform and Pisiform Bones, is the *Inner Lateral* or *Cubito-Carpal Ligament.*

The motions of the Wrist-Joint in reference to the Spoke-bone are flexion and extension, as already stated, and also adduction and abduction, or inclination of the inner or outer side of the Hand to the corresponding sides of the Fore Arm; the motions of the Hand being also still further increased by the consecutive performance of flexion, adduction, extension, and abduction, by means of which the points of the fingers are capable of applying themselves to any point of a circle of a certain diameter, or to any part within its periphery. The extent of this circumduction is also further increased by the semicircular movement of the base of the Spoke-bone around the lower end of the Cubit. Thus is shown the first part of the mechanical arrangement by which the delicate and complicated motions of the Hand are performed, the remainder of which will be seen after considering the bony structure of the Fingers.

Of the Carpal Joints.

The Wrist-Bones are connected to each other by ligamentous slips passing in almost every direction upon their fore and hind surfaces, and hence called *Palmar* and *Dorsal Ligaments;* besides which there are others, very short, passing from the side of one bone to that of another, in such parts as have no articular surfaces, and called from their position *Interosseal*, of which those of the second row are the most extended, though equally short with the upper, and admitting of very slight sliding motion of the bones upon each other. The junction of the Pisiform with the Cuneiform Bone is distinguished from the others in being effected by a proper *Capsular Ligament.* As the upper row of Carpal bones form the ball of the Wrist-Joint already mentioned, so does the head of the Great Bone form the ball which is received into the socket of the first row, consisting of the Scaphoid and Lunar Bones; but there is no distinct capsular joint, and the whole connexion of the upper with the lower row of the Carpus leaves one common joint between all the articular surfaces entering into it. The separation of the sides of the Carpal Bones from each other is also mainly prevented by the strong ligamentous band, the *Anterior Ligament of the Wrist-Joint*, which passes from the Pisiform and Unciform bones on the inner, to the Scaphoid and Trapezial bones on the outer side, and connects the piers of the arch so as to prevent them splaying out when a violent blow is received upon the back of the wrist or crown of the arch, the part where such violence is commonly received, and where it would be most severely felt were it not for this connexion of the two piers of the Carpal Arch. This ligament, together with the Carpal Arch, forms a ring through which the flexor tendons pass into the Palm, and are prevented starting from their place on violent flexion of the fingers; and when the Hand is flexed upon the Arm, it serves the further purpose of a pulley-wheel, over which the same tendons perform their actions.

b. The Mid-hand Bones (*Ossa Metacarpi, seu Metacarpus*, Lat.; *die Mittelhand*, Germ.; *le Métacarpe*, Fr.) (Fig. XXXV.)

Consist of five irregularly cylindrical bones placed between the Carpal Arch above and the fingers below, and corresponding with the Mid foot, but differ in being shorter and comparatively stronger, excepting the bone belonging to the Thumb, which is smaller than the corresponding one of the Great Toe, and is further distinguished by being movable upon the Carpus, whilst the Great Toe is immovable on the

Anatomy. Tarsus. The inner four Mid-hand Bones belong to the Fingers, and, like the Fore Arm, face backwards and forwards; the outer one, which forms part of the Thumb, faces inwards and outwards. All five have *bases* or upper, *bodies* or middle, and *heads* or lower parts; but those belonging to the Fingers differ materially from that of the Thumb, and in a less degree from each other.

The *bases* of those belonging to the Fingers are mostly of a triangular form, the base of the triangle facing backwards and its apex forwards, and each has upon it articular surfaces for junction with the Wrist-bones. The *first*, which belongs to the Fore finger, has on its outer edge a small articular surface corresponding to one on the Trapezial bone, a large one in the middle for the Trapezoid, and on the inner side one for the Great bone. The *second*, which supports the Middle finger, has one large surface for the principal surface on the Great bone. The *third*, connected with the Ring-finger, has on its outer side a small one for part of the Great bone, and on its inner a large one for part of the Unciform bone: and the *fourth*, which joins the Little finger, has a large one for the remainder of the Unciform bone. All these surfaces and their correspondents are nearly flat, and preclude more than a slight yielding motion similar to that between the Wrist-bones; and as they are closely approximated, the corresponding sides of the bases have small articular surfaces for each other.

The front surfaces of the *bodies* of these bones are sharp and keel-shaped, as they are also at their back near the base; but towards the heads they are expanded behind, so that they there assume a prismatic form.

The *heads* are rounded from before to behind and from side to side, more in the former than in the latter direction, and on each side, above the articular surfaces on the head, is a little depression in which ligaments are fixed.

The bone belonging to the Thumb is shorter than the others, is flat within and convex from before to behind without: its *base* differs from that of the others in having such form, that is, an articular surface concave from without to within, and convex from before to behind, as allows a double hinge-motion; viz.—from before to behind, and from within to without, upon the Trapezial bone: its *body* is nearly flat without, and convex before to behind within: its *head* has a broad articular surface commencing only from the end of the shaft, and slightly rounded inwards.

Junction of the Wrist and Mid hand.

The junction of the inner four bones of the Mid hand with the second row of the Wrist-bones being by flat or nearly flat surfaces, and no more than slight yielding motion being performed between them, they are connected on the back and front by short flat ligaments, and included in a common synovial capsule. The Thumb-bone, however, is connected to the Trapezial by a distinct loose capsular ligament and synovial membrane, so that motion can be performed on the latter bone in any direction, as flexion or drawing the thumb across the Palm, extension or carrying it outwards, adduction or bringing it to the Fore finger, abduction or carrying it forwards from the Palm, or a successive alternation of these motions, by which circumduction is effected, in which the base of the bone is moving upon the small space formed by the articular surface of the Trapezial bone, whilst the head describes a comparatively large circle. Anatomy.

c. The Fingers (*Phalanges Digitorum Manus*, Lat.; *die Finger-glieder*, Germ.; *les Doigts*, Fr.) (Figs XXXVI., XXXVII.).

The four Fingers and the Thumb consist together of fourteen bones, ranged in three rows to the former and two to the latter, corresponding to the rows of the Toe-joints, but differing from them in their greater length and strength, except as relates to the Thumb and the Great Toe. They are situated immediately below the Mid hand. The first two rows of the Phalanges or Joints of the Fingers (fig. XXXVI.), as they are indiscriminately called, have a general resemblance in having their *bodies* rounded behind from side to side and flattened in front. The upper ends or *bases* (a.) of the first row are shallow cups, received on but not completely covering the heads of the Mid-hand bones; their lower ends or *heads* (b.) are convex from before to behind, the articular surfaces extending further forwards than behind, and concave from side to side, corresponding with the lateral depressions and middle convexity on the base of each bone of the second row. The second row are shorter than the first: their *bases* (a.) have been just spoken of; their *heads* (b.) are similar to those of the first row, and correspond with the bases of the third row. The third row are the shortest of all; their *bases* are similar to those of the second; instead of heads their lower ends or *tips* (b.) are much flattened, and spread out somewhat like the bowl of a spoon, to give greater breadth behind for the attachment of the nails, hence they are called the Nail-joints, and to enlarge in front the space upon which the extreme branches of the nerves of Touch are expanded.

The Thumb (fig. XXXVII.) has but two rows correspondent with the first and third of the Fingers, but which are larger; the *base* of the upper one is shallow and concave from within to without; the *base* of the lower similar to that of the Fingers.

At the base of the first joint of the Thumb, and also at that of the Little Finger, a pair of small bones called Sesamoid are frequently found.

Joints of the Fingers and Thumb with the Mid hand, and of the rows of the former with each other.

All the bones of the Fingers and Thumb are connected with each other and with the Mid hand by capsular ligaments lined with synovial membrane: those connecting the first row of the Fingers to the Mid hand by capsular ligaments only, which allow of their flexion forwards at right angles with the Palm of the Hand, and when extended to the same plane as its back, which they cannot exceed, admit of slight lateral motion. The other rows of the Fingers, however, together with the junction of the upper bone of the Thumb above, to its Mid-hand bone, and below to the second row, are strengthened on the lateral parts of the former, and on the fore and back parts of the latter, by narrow flat, or, as they are commonly called, *lateral* ligaments, which preclude any lateral motion; and thus the movements of the finger-joints upon each other, and of the thumb upon itself, and on its Mid-hand bone, are merely flexion and extension, or a hinge-motion.

ANATOMY.

SECTION II.

OF THE MUSCLES.

The variety in form and attachment of Muscles having been already treated of in the Essay on ZOOLOGY, p. 175, their arrangement on the Human Subject is now to be considered. The disposition of the Muscles upon the skeleton is not simply for locomotion and for the movement of its several parts upon each other, but also for the bracing up and support, either in the erect or in any particular position, of the whole skeleton or any of its pieces; and, in the latter case, to furnish fixed points upon which neighbouring bones, either above or below, may be moved. Thus, though the Muscles of the lower limbs sustain their erect posture, and also that of the whole trunk, the Muscles of the foot and leg may retain the leg upright, whilst those connecting the latter with the thigh can bend and again extend that part of the lower limb upon it; or the same Muscles which have performed these motions can fix the leg in any position upon the thigh, whilst the Muscles of the foot are left free to move it upon the leg. Hence it appears that all Muscles attached to parts movable on each other are capable of assuming either as the fixed point from which the motion is commenced; the terms origin and insertion therefore do not really determine always, though generally, which is the fixed and which the moving attachment. This variation of the fulcrum, and the less or greater contraction of a Muscle, by which its attachments are less or more approximated, together with the concurrent, successive, or alternate actions of many Muscles connecting the same parts, though but little distant from each other, are the cause of the delicate and almost innumerable variety of motions performed by many parts of the body, of which those of the hand are the most remarkable, excepting those which influence the soft parts of the face, and make of it a book on which are inscribed the varied passions of the mind.

It is a difficult matter to determine where to commence the description of the Muscles, and whether to describe them as they are successively laid bare by the dissecting knife, or to class them in reference to their connexion with parts which they most generally move. The latter method has the inconvenience of occasionally having to remove Muscles not previously examined, but which are unconnected with the parts whose Muscles are under consideration; but this is of less consequence than the confusion which ensues from the former method, by which the moving powers of any particular part are indiscriminately lotted together on account of their position.

1.—OF THE MUSCLES OF THE HEAD.

The Muscles of the Head are divided, 1st, into those connecting the Skull with and moving it directly upon the Trunk, of which all but one pair originate from the Spine; 2ndly, those commonly called the Muscles of the Face, including the Muscles of the Mouth, Nose, Eyes, and Auricles , and, 3rdly, the Maxillary Muscles, in connexion with which must be considered all the other Muscles attached to the Tongue-bone and Larynx, many of which by means of the Lower Jaw act indirectly upon the Skull.

a.—Of the Muscles moving the Skull.

From the position of the Skull upon the summit of the Spine, and from the mobility of the cervical pieces of the Vertebral column, the greater number of the Muscles inserted into the Skull assist materially in the performance of the motions of the neck. Of these Muscles, seven pairs are placed on the back of the chest and neck, and four pairs upon the front of the neck, one of which arises from the top of the chest.

The *M. Trapezii*, *Rhomboidei*, and *Serrati Postici Superiores* having been removed, the *M. Splenii* are seen rising up from the top of the dorsal spine, and inclining outwards from the middle of the neck as they pass towards the occipital bone, leaving between them a space resembling that contained within the legs of the letter V, in which the *M. Complexi* are observed passing up to the back of the Skull.

M. Splenius (Pl. VII. xx.) is a flat Muscle which arises from the upper four dorsal and the lower five cervical spines; the fibres ascend upwards and outwards, and are inserted in two portions, the lower one by so many tendons into the transverse processes of the upper five neck vertebres, and the upper one into the back of the mastoid process of the temporal bone; the former is often called *M. Splenius Colli*, and the latter *M. Splenius Capitis*. *Use.*—When the pair of Muscles act they pull the head and neck back upon the dorsal spine; but if only one act, it inclines the head backwards and to the opposite side, and turns the face upwards.

M. Complexus (Pl. VII. xx.*) is so called from the large intermingling of tendinous fibres in its muscular part, one of which is so largely developed that the muscular parts with which it is connected have been named *M. Biventer Cervicis*, as if it were a distinct Muscle. The origin of this Muscle is from the transverse processes of the upper seven back vertebres, between the *M. Longissimus* and *Spinalis Dorsi*, also from the transverse processes of the under four neck vertebres by so many tendons, and from the first dorsal spine by a little fleshy belly. The Muscle increases in breadth as it ascends, and it is inserted into the space on the occipital bone between its greater and little transverse ridge. *Use.*—It draws backwards or extends the head and neck upon the back.

On the outer edge of the last is situated a thin narrow Muscle,

M. Trachelo-mastoideus, which originates by thin

tendons from the transverse processes of the upper three dorsal and the lower five cervical vertebres; it ascends vertically, and is inserted into the back of the mastoid process. *Use.*—When both Muscles act they assist in steadying the head; but if one only, it sways the head to that side and backwards.

The remaining four pairs of Muscles are short Muscles, and are seen by turning off the top of the *M. Complexus;* three of them are inserted into the Skull, and the fourth acts upon it, as if it were attached to it, by its insertion into the first neck vertebre.

M. Rectus Capitis Posticus Major arises from the second cervical spine, expands, as it ascends, like a fan, and is inserted into the little transverse ridge of the occipital bone.

M. Rectus Capitis Posticus Minor is covered by the former, having its origin from the little stud on the back of the ring of the first cervical vertebre; it is inserted fleshy into the pit above the great occipital hole. *Use.*—These Muscles extend the Skull back upon the vertebres whence they arise.

M. Obliquus Capitis Inferior is for its size a bulky Muscle; it arises fleshy from the spine of the second cervical vertebre, runs outwards and a little upwards, to be inserted into the transverse process of the Atlas. *Use.*—It turns the Atlas round to the side from whence it arises, and with it also moves the Skull; but if both Muscles act together they steady the Skull.

M. Obliquus Capitis Superior arises from the transverse process of the first neck vertebre tendinous, runs upwards and inwards, and is inserted into the occipital bone close to the mastoid process of the temporal bone. *Use.*—This pair is one of those which may be called muscular ligaments; they effect but little motion of the Skull, and that is extension.

The antagonists of the seven Muscles just mentioned are, three out of the four, Muscles of small size, as the exertions they have to make are trifling, in consequence of the weight of the head preponderating in front of the spine.

M. Rectus Capitis Anticus Major arises tendinous and fleshy from the roots of the transverse processes of the third and three following cervical vertebres; it ascends, and is inserted into the basilar process of the occipital bone. *Use.*—It bends the Skull forwards upon the Neck, and also the upper part of the Neck upon itself.

M. Rectus Capitis Anticus Minor arises from the front of the ring of the first cervical vertebre, and it is inserted near the root of the condyle of the occipital bone. *Use.*—It is little more than a muscular ligament.

M. Rectus Capitis Lateralis arises from the transverse process of the first cervical vertebre; its short fibres pass directly upwards, and are inserted into the occipital bone behind, and to the outside of the jugular pit. *Use.*—No more than a muscular ligament.

M. Sterno-cleido-mastoideus (Pl. VI. n.).—This large pair of muscles, which pass from the fore part of the chest backwards and upwards behind the ears, are really the antagonists of all the extensor Muscles of the Head and Cervical Spine. It arises by a strong tendon from the front of the upper piece of the breast-bone, and from the inner upper third of the collar-bone by a fleshy origin; its fibres form a broad powerful Muscle, which runs upwards, and is inserted with tendinous fibres intermixed around the mastoid process, and from its root backwards to the lambdoidal suture. *Use.*—If both Muscles act together, they pull the head down to the chest, at the same time bending the neck; if one act, it turns the face to the opposite shoulder, and draws the head down to its own side; if the two act alternately, they assist the *M. Obliqui Posteri Inferiores* in rotating the first on the second vertebre.

b.—Of the Muscles upon the Face.

First, of those belonging to the Mouth.

These consist of nine pairs, and a single circular Muscle, made up by the coalescence of the others. Each lip is furnished with three pairs, and into the corners of the mouth are inserted three pairs.

M. Levator Labii Superioris (Pl. X., fig. 1. a.) arises from the front of the orbitar process of the upper jawbone, above the infra-orbitar pit, and it is inserted into the middle of the upper lip.

M. Depressor Labii Superioris is within the mouth, and is but a short small Muscle: it arises from the root of the alveolar process of the upper jaw, which supports the incisive teeth, and is inserted into the upper lip.

M. Levator Anguli Oris (fig. 1. b.) arises from the front of the upper jaw below the infra-orbitar pit, and is inserted into the upper lip near the corner of the mouth.

M. Depressor Anguli Oris (fig. 1. c.) arises from the fore and lateral part of the base of the lower jaw by a wide origin. Its fibres collect, and it passes upwards to be inserted into the lower lip near the angle of the mouth.

M. Depressor Labii Inferioris (fig. 1. d.) arises from the front and lateral part of the chin, partially covered by the last Muscle: it is inserted into the lower lip.

M. Levator Labii Inferioris is within the mouth, and arises from the alveolar process, supporting the outer incisive tooth in the lower jaw: it is inserted into the inside of the lower lip. The *Uses* of the preceding six muscles are implied in their names.

M. Zygomaticus Major (fig. 1. e.) is a narrow long Muscle arising from the zygomatic arch, and ascends to be inserted into the corner of the mouth.

M. Zygomaticus Minor (fig. 1. f.) is placed in front of the last Muscle, arising from the prominence of the cheek-bone: it is inserted into the angle of the mouth before the last. *Use.*—Both these Muscles draw up the corners of the mouth, especially in grinning.

M. Buccinator (fig. 1. g., IX. g.), so called from its employment by trumpeters. It is a very large Muscle, forming the lateral boundary of the mouth and cheek: it arises from the upper jaw behind the last molar tooth, and from the lower jaw at the same point; its fibres pass forwards, and are inserted into the corner of the mouth. *Use.*—Its principal function is to thrust the food between the teeth, when it has been pushed outwards by the tongue during mastication.

M. Orbicularis Oris (fig. 1. h.) is a circular muscle included in the red part of the lips. *Use.*—It closes, or, in common language, purses up the mouth, and it antagonizes all the nine pairs of Muscles just described.

Secondly, of the Muscles belonging to the Nose.

These are two pairs.

M. Levator Alæ Nasi (fig. 1. i.) arises from the nasal process of the upper jaw-bone; it descends by the side of the nose, and is inserted into the outside of its alar cartilage. *Use.*—If the pair of Muscles act, they expand the nostrils, as in sniffing.

M. Compressor Nasi (fig. 1. j.) arises from the root of the nasal process of the upper jaw at the under and

outer part of the front orifice of the nostrils: its narrow band of fibres passes upwards and mounts over the cartilages just below the nasal bones, where it joins its fellow. *Use.*—It compresses the nose in snorting.

Thirdly. The Muscles belonging to each Eye and its appendages consist of ten, four of which are exterior to the orbit, and six are contained within it.

The Muscles belonging to the Eyebrows are two.

M. Occipito-frontalis (fig. I. k.) is a broad thin Muscle originating from the upper edge of the great transverse occipital ridge, and coalescing with its fellow at the occipital tubercle; it ascends as a thin Muscle about an inch and a half from this ridge, then becomes tendinous, expands over the whole surface of the head in a tendinous form, being closely connected with the bed of the hair, and loosely with the subjacent pericranium; upon the forehead it again becomes fleshy, and is lost by insertion into the eyebrow. *Use.*—It raises the Eyebrows, as observed in the expression of surprise, and it also draws forward or backward the scalp, as its front or back muscular attachment acts.

M. Corrugator Supercilii (fig. I. l.) is covered by the next Muscle: it originates from the inner angular process of the frontal bone, passes upwards and outwards, and is inserted into the inner end of the cellular tissue supporting the Eyebrow. *Use.*—It antagonizes the last Muscle, drawing the Eyebrow down, or knitting the Eyebrow, as it is commonly called, either in frowning or in deep thought.

The Muscles of the Eyelids are two, one external to the orbit, the

M. Orbicularis Palpebrarum (fig. I. m.), which is a thin expanded circular Muscle spread upon and above the upper, and upon and below the lower eyelid, and closely connected at the inner corner of the orbit with the ligament by which the cartilages of the eyelids are connected with the nasal process of the upper jaw-bone. *Use.*—It closes the Eyelids.

The lower Eyelid, from its own weight, drops when the *M. Orbicularis* is inactive, and therefore requires no Muscle; but to keep the upper Eyelid raised it requires a Muscle, which is situated in the orbit, together with the Muscles of the globe.

M. Levator Palpebræ Superioris (Anat. Pl. XI., fig. IV. b.) arises tendinous from the upper edge of the optic hole, becomes muscular as it expands, and elongated forwards, and is inserted by a broad delicate tendon into the cartilage of the Upper Eyelid.

The Muscles of the Globe of the Eye consist of six, four straight and two oblique; the

M. Recti Oculi (fig. IV. c. d. e. f.) all originate tendinous from the optic hole, and are called, from their use, the upper *Levator* (c.), the under *Depressor* (e.), the inner *Adductor* (f.), and the outer *Abductor Oculi* (d.); each forms a long narrow fleshy belly, which terminates in a tendon to be inserted into the sclerotic coat of the Eye where the conjunctive coat is reflected from the globe on to the eyelids; the tendons then spread out upon the globe of the eye, and, expanding beneath the just named tunic, form the so-called White of the Eye, being inserted as far as that transparent cornea.

The *Use* of the several Muscles is implied in their names.

M. Obliquus Superior Oculi arises from the optic hole between the tendinous origins of the *M. Levator* and *Adductor;* it soon becomes fleshy, runs along the upper edge of the latter Muscle, and, as it approaches the inner corner of the orbit, terminates in a tendinous cord which runs over a little ligamentous loop attached to the inner angular process of the frontal bone, then descends and is inserted into the under part of the globe about its middle. *Use.*—It turns the front of the globe upwards and inwards, as in the expression of hope.

M. Obliquus Inferior Oculi (fig. IV. g.) is a short Muscle originating from the orbitar process of the upper jaw-bone near its junction with the lachrymal; it runs outwards fleshy, and is inserted tendinous into the middle of the outside of the globe. *Use.*—It turns the front of the globe outwards and downwards, and gives expression to suspicion.

If both the Oblique Muscles act together, the globe obeys neither, but a third motion is produced which causes squinting.

Fourthly. The Muscles of each Auricle are divided into those which move it upon the Skull, and those which move its cartilaginous pieces upon each other; the former consist of three or four, the latter of five. It is necessary, however, here to mention very cursorily the parts of which the Auricle is composed. It is divided into the *lobe* or lower part, which consists only of a doubling of the skin containing fat, and is the part pierced for ear-rings; and the *pinna* or *gristly part*, which is composed of cartilage covered with skin; the latter is divided into elevations and depressions: the marginal elevation is called *helix*, a little in front of which is the *antihelix*, the two being separated by the *fossa innominata*, or unnamed pit; and in front of the antihelix is a large cavity called, from the resemblance to the open mouth of a horn, *concha*, which leads down to the external auditory passage; in front of the concha, like a little valve, which, in some animals, it really is, is the *tragus;* and opposite it and behind, at the termination of the antihelix, is a little elevation called the *antitragus*.

M. Attollens Auriculæ (Pl. X., fig. I. n.; Pl. XI., figs. XXVI. & XXVII. a.) is a thin fan-shaped Muscle on the side of the temple, from the cellular tissue of which it arises; its fibres collect, descend, and are inserted at the back of the fossa scaphoides. *Use.*—It raises the auricle, and has no antagonist, the weight of the auricle restoring it to its original place when this Muscle ceases to act.

M. Attrahens Auriculæ (figs. XXVI. & XXVII. b.) is a short small Muscle arising from the root of the zygomatic process of the temporal bone, and is inserted into the root of the front of the helix.

M. Retrahentes Auriculæ (Pl. X., figs. I. o.; Pl. XI., figs. XXVI. and XXVII. c. c.).—Sometimes two, but often only one short and delicate Muscle, originating from the root of the mastoid process, and inserted into the back of the conch. The *Uses* of the last two Muscles are implied in their name, and they are antagonists.

Four of the five Muscles of the Auricular Cartilages are placed on their external surface, and tend to vary the depth of the auricular cavity by drawing the cartilages together: they are called—

M. Helicis Major (fig. XXVI. d.)
M. Helicis Minor (ib. e.)
M. Tragicus (ib. f.)
M. Antitragicus (ib. g.)

These are all antagonized by a single muscle,

M. Transversus Auris (fig. XXVII. d.), situated on

the back of the concha and antihelix, which renders the auricular cavity shallow.

c.—Of the Muscles of the Lower Jaw.

The proper Muscles of the Lower Jaw, or Masticating Muscles, consist only of seven pairs, four of which elevate and rotate it, and the other three depress it.

M. Temporalis (fig. II. p.) is the largest and most powerful; it arises fleshy from the whole temporal pit, and from the inside of a strong fascia which is attached to the temporal ridge of the frontal, parietal, and temporal bones above, and the zygomatic arch below; it is inserted tendinous and fleshy around the whole coronoid process of the lower jaw. *Use.*—It elevates the jaw very powerfully, and draws it backwards.

M. Masseter (fig. I. q.) originates from the under part of the zygomatic process or prominence of the cheek, consists of bundles of fleshy fibres intermingled with tendon, and is inserted tendinous and fleshy upon the outside of the angle of the lower jaw. *Use.*—It elevates the lower jaw, and draws it forwards.

Within the arch of the lower jaw and behind, are found the other two pairs.

M. Pterygoideus Internus (fig. III. r.), which arises from the pterygoid pit of the sphenoid bone fleshy, passes downwards and backwards, and is inserted on the inside of the angle of the jaw, corresponding to the insertion of *M. Temporalis.* *Use.*—Similar to the last Muscle.

M. Pterygoideus Externus (fig. III. s.) is a short, thick, bulky, horizontal Muscle, arising from the whole outer surface of the muscular plate of the pterygoid process of the sphenoid bone; it passes a little backwards, and is inserted into the inside of the neck of the lower jaw. *Use.*—The Internal Pterygoid Muscles act for the most part singly, and alternately bring forward one or other side of the jaw, thus rubbing or grinding the teeth together, and principally perform the office of breaking up the food between the grinding teeth.

The Muscles which depress the Lower Jaw are all connected with the hyoideal or tongue bone, and this being movable, or rather suspended by ligament and muscles between the styloid processes of the temporal bones and the top of the air-tube, it will be necessary, before describing them, to give a short account of the Larynx, as the crowning and most important part of the Air-tube is called.

The Larynx is placed at the top of the Windpipe, *trachea*, and consists of five cartilages, the largest of which, occupying the front, and resembling in its form the half-opened boards of a book, is called the *Thyroid cartilage*, from its shielding the smaller cartilages and other important parts; its two sides, called *wings*, join in front, forming the projection remarkable in the male, and known as *Adam's apple;* behind, each wing terminates in an *ascending horn*, connected by a round ligament to each horn of the tongue-bone, and below by a shorter and *descending horn*, which is united by a ligamentous capsule on each side to the Cricoid cartilage; an expanded ligament connects the lower edge of the wings also with the same cartilage, and by another broad ligament their upper edge is attached to the lower margin of the tongue-bone. The *Cricoid Cartilage*, named from its resemblance to a ring, is placed below the last, and attached by its lower edge to the top of the Windpipe; it is narrow in front, where joined to the Thyroid, but deepened considerably behind, and has attached, by capsular ligaments to its top, a pair of triangular cartilages called the *Arytænoid.* From the base of these to the back of the junction of the wings of the Thyroid Cartilage, a pair of ligaments, called the *Vocal chords*, are stretched, and the aperture between these is called the *Chink of the Glottis.* As the food in passing from the mouth into the gullet, which is placed behind the Larynx, must necessarily pass over this chink, it requires a covering to prevent the food getting into the Larynx, which, however, a small quantity sometimes does, and is then, in common language, said to have gone the wrong way, and causes suffocation; this covering is furnished by the fifth cartilage, called the *Epiglottis*, which covers it like a trap-door, but with this difference, that whilst in a trap the door drops down into or upon its frame, in this case the frame or chink of the glottis is raised up to it, and the epiglottis, which is naturally upright, then falls upon it, and forms a shoot from the back of the tongue over which the food readily glides without the possibility of getting into the Larynx.

The Tongue-bone is prevented ascending directly by three pairs of Muscles which are inserted into it, and indirectly by two pairs which are attached to the Laryngeal cartilages; hence it affords a fixed attachment for the Muscles depressing the Lower Jaw.

M. Sterno-hyoideus (figs. IV. and V. a. a.).—A long narrow Muscle arises by a thin tendon from the back of the first piece of the breast-bone, from the sterno-clavicular articulation, and from the inner end of the collar-bone; it is inserted into the lower edge of the base of the tongue-bone.

M. Omo-hyoideus (fig. IV. b.) is a long two-bellied Muscle, commencing from the ligament of the upper notch of the blade-bone, from which it ascends fleshy to the hind edge of the *M. Sterno-mastoideus*, becomes tendinous, and passing on its inner side, emerges from its front edge, again becomes muscular, and ascends nearly vertically to be inserted into the base of the tongue-bone externally to the preceding Muscle.

M. Thyro-hyoideus (fig. IV. c.) is covered by the *M. Sterno-thyroideus*, which, being turned off, exhibits its origin from the upper edge of a transverse ridge upon the outer surface of the wing of the thyroid cartilage; it is inserted into the base of the tongue-bone.

M. Sterno-thyroideus (fig. IV. d.) arises from the back of the first piece of the breast-bone and from the cartilage of the first rib; it ascends upon the side of the windpipe, to be inserted into the tranverse ridge of the thyroid cartilage below the origin of the last Muscle.

M. Crico-thyroideus (fig. VI. c.) is a little triangular Muscle, with its tip or origin below, from the front of the cricoid cartilage; it runs upwards and backwards to be inserted into the lower edge and root of the lower horn of the thyroid cartilage.

All these five Muscles, if the depressors of the jaw were inactive, would pull down the tongue-bone and the whole Larynx and Windpipe towards the chest; and even when these Muscles do act, they assist them by pulling down the tongue-bone and Larynx still further. But they are now to be considered as preserving the fixed position of the tongue-bone against the operation of the depressing Muscles of the Jaw, which, when so acting, strive to pull the tongue-bone and Larynx upwards.

M. Digastricus (fig. IV. f. f.) is, as its name implies, double-bellied; it arises fleshy from the digastric pit of the temporal bones, passes downwards and forwards towards the appendage of the tongue-bone, to which a ligamentous loop is attached, and through it the middle tendon of this Muscle plays; it then again becomes fleshy, ascends to the base of the chin, and here is inserted tendinous and fleshy.

M. Mylo-hyoideus (figs. IV. & IX. g.) is a broad, expanded Muscle, covered before by the anterior belly of the last Muscle; it arises from the upper edge of the base of the tongue-bone, joins its fellow in front, and, ascending, is inserted fleshy into the inside of the lower jaw, from the back of the chin to opposite the root of the last molar tooth.

M. Genio-hyoideus (fig. IV. h.) is a straight Muscle, not seen till the junction of the last pair of Muscles has been divided; it arises from the base of the tongue-bone, and, becoming tendinous, is inserted into the little spine at the back of the chin.

The three Muscles just described, when the jaw is kept closed by its elevating Muscles, pull up the tongue-bone, and with it thrust up the Tongue against the bony palate, in which they are also assisted by another pair of Muscles, the

M. Stylo-hyoideus (fig. VII. i.), placed before the hind belly of the *M. Digastricus*, and arising from the lower half of the styloid process of the temporal bone; it is inserted into the tongue-bone at the junction of its horn with its base.

In connexion also with the tongue-bone and styloid process of the temporal bone, are

THE MUSCLES OF THE TONGUE:

These consist of three pairs, and a fourth, which is attached only to the Tongue, and indeed forms the principal part of its structure, and moves it upon itself.

M. Hyo-glossus (fig. VII. k.) arises from the upper edge of the tongue-bone, and is inserted into the under and middle part of the tongue. *Use.*—It depresses the middle of the Tongue, and renders it spoon-shaped.

M. Genio-hyo-glossus (fig. VII. l.) is a fan-shaped Muscle, arising from the little stud at the back of the chin, is attached below to the base of the tongue-bone, and is inserted into the under part of the Tongue behind its anterior third. *Use.*—Its actions are very numerous: if the whole Muscle acts, it draws down and renders the middle of the Tongue concave; if the front and back fibres act simultaneously, they help to render the Tongue convex from before to behind; by the action of its posterior fibres the Tongue is projected from the mouth, and the anterior fibres being rendered tense, are then capable of drawing the tongue back again; the part connected with the tongue-bone depresses the jaw if that bone be fixed, or elevates it if the jaws are kept close.

M. Stylo-glossus (fig. VII. m.) arises from the styloid process above the *M. Stylo-hyoideus*, is a slender fleshy Muscle, runs along the under part of the Tongue from its base, and is inserted into its tip. *Use.*—It assists the former Muscle in drawing the Tongue back into the mouth, and the *M. Hyo-glossus* in rendering it spoon-shaped, by raising its base.

M. Lingualis (fig. VII. j.).—This is the proper Muscle of the Tongue, and passes longitudinally from its base to its tip, between the *M. Hyo-glossus* and *Genio-hyo-glossus*. *Use.*—By the contraction of the pair, the sides of the Tongue are shortened, and it is rendered convex laterally.

The cavity of the Mouth is separated from the pharynx, or top of the gullet, by means of a pendulous curtain, *velum palati*, from the hind edge of the bony palate, consisting of a doubling of the delicate skin lining the mouth and gullet, in which are included certain Muscles. This curtain is attached to the Tongue in front by one pair of pillars, as they are called, and to the sides of the gullet by another pair, and each of these contain a pair of Muscles; the curtain itself is moved by two pairs of Muscles; and the little body called the *uvula*, pendulous from the middle of the curtain, has also its single Muscle.

M. Palato-glossus is placed in the anterior pillar, arises from the side of the base of the Tongue, and is inserted into the soft palate.

M. Palato-pharyngeus, situated in the posterior pillar, arises from the side of the gullet, and is inserted into the soft palate, where it blends with the last Muscle. *Use.*—Both these Muscles approximate the base of the Tongue and soft palate, and cut off the communication between the mouth and pharynx; which action is completed by

M. Tensor Palati (fig. VIII. o.).—This small Muscle arises tendinous and fleshy from the spinous process of the sphenoid, and from the under part of the whole Eustachian tube; as it descends it becomes tendinous, plays around the hamular process of the sphenoid bone, and ascending as a thin expanded tendon is inserted into the soft palate.

Its antagonist is a Muscle close to and behind it, but the tendon of which does not accompany it, viz.,

M. Levator Palati (fig. VIII. p.).—It arises from the under part of the petrous portion of the temporal bone, and from the Eustachian tube, and it is inserted into the soft palate. *Use.*—It elevates the soft palate, bringing it upon the same plane as the bony palate, and cuts off the communication between the pharynx and nostrils.

M. Azygos Uvulæ (fig. VIII. q.) is a single Muscle arising from the hind point of the palatine crest; it descends into the Uvula, where it terminates. *Use.*—This is probably to assist the intonation of the voice by increasing the aperture of the arch of the *fauces* or swallow.

Behind the soft palate, and descending from the under part of the basilar process of the occipital bone, from the pterygoid processes of the sphenoid bone, and from the back of both jaws, is a large muscular funnel called the Pharynx or gullet, which consists of five pairs of Muscles: two of these expand and raise it to receive the food as it is thrown backwards from the mouth, and the other three alternately compress and squeeze it down into the œsophagus; of the expanding and elevating Muscles, one pair, the *M. Palato-pharyngei*, have been already described; the other is *M. Stylo-pharyngeus* (fig. VII. r.) which arises fleshy from the styloid process of the temporal bone, and is inserted into the side of the pharynx.

The compressing Muscles are the

M. Constrictor, *Superior*, *Medius*, and *Inferior Pharyngis* (fig. IX. s. t. u.). The *first* of these arises from the occipital, sphenoid, upper and lower jaw-bones; the *second* from the occipital bone, and from a seam which runs between the two Muscles forming this pair; and the *third* from a continuation of the same seam.

The first of the three is inserted into the middle of the back of the pharynx in a white seam, and the two latter into the sides of the thyroid and cricoid cartilages. *Use.*—The first of the three is, strictly speaking, only an elevator of the pharynx; the other two, however, both elevate and narrow its diameter.

Muscles of the Larynx.

The Muscles of this organ may be divided into those which change its position in the Neck, and consequently lengthen or shorten the air-tube, and those which move its several pieces in such manner as to operate upon its chink and upon the vocal chords. Of the former kind are all the Muscles which elevate or depress the tongue-bone; but of the latter, only one pair, the *M. Crico-thyroidei*, have been yet described; besides which, there are four pairs and a single Muscle, which move the Arytænoid upon the Cricoid cartilage, and two pairs which approximate the Epiglottis and the Laryngeal chink.

M. Crico-Arytænoideus Posticus (fig. x. a.) arises fleshy from the hind broad part of the Cricoid cartilage, and is inserted into the base of the Arytænoid.

M. Crico-Arytænoideus Lateralis (fig. xi. b.) is smaller, arises from the side of the Cricoid, and covered by the wing of the Thyroid cartilage; it is inserted into the side of the base of the Arytænoid. *Use.*—Both these Muscles open the chink of the Larynx, the former from before to behind, at the same time tightening the vocal chords, and the latter from side to side by pulling them apart.

The antagonist of the first of the Muscles is

M. Thyro-Arytænoideus (fig. xi. c.), which, arising from the inside of the wing of the Thyroid, is inserted above the last into the Arytænoid cartilage.

The antagonist of the second is

M. Arytænoideus Obliquus (figs. x. & xi. d.), which, arising from the back of the base of one Arytænoid, is inserted into the tip of the other Arytænoid cartilage; the two Muscles of this pair therefore decussate like a St. Andrew's cross. *Use.*—Both diminish the aperture of the Larynx, and render the vocal chords loose.

M. Arytænoideus Transversus is a single Muscle running from the inner edge of one to that of the other Arytænoid cartilage. *Use.*—It approximates the cartilages, and helps to close the chink.

The Muscles operating on the Epiglottis especially are two, very thin and delicate, and discernible only in very muscular subjects; they are called

M. Arytæno-Epiglottideus and

M. Thyro-Epiglottideus;

The former arising from the Arytænoid, and the latter from the Thyroid cartilage, and both are inserted into the side of the Epiglottis. *Use.*—It is probable that their use is only to adjust nicely the Epiglottis upon the top of the Larynx, as the Arytænoid cartilages and vocal chords, with the intervening chink, are actually raised to the Epiglottis by those Muscles which raise the tongue-bone.

Of the Muscles of Respiration.

These consist of two kinds; those which operate directly upon the Chest, and those which act indirectly upon it by the reversion of their actions; such are all the Muscles connecting the Upper Extremities with the Chest, and already described, viz., *M. Pectoralis Major* and *Minor*, and *Serratus Magnus;* also those which bow the body forwards upon the pelvis, the *M. Rectus*, *Externus* and *Internus Abdominis*, and the pair which steady it, *M. Quadratus Lumborum*, all of which are called into action only in difficult respiration. But the former kind may also be subdivided into three sets,—supporters of the Chest, elevators, and depressors of the Ribs.

1. The *supporting Muscles* of the Chest consist of four pairs: one of them has been already described as acting specially upon the head, the *M. Sterno-cleido-mastoideus*, but from its attachment to the upper piece of the breast-bone it assists in holding up and fixing the top of the chest, rendering it the point upon which the other ribs are moved. The proper suspending Muscles are, however, the

M. Scalenus Anticus, *Medius*, and *Posticus* (Pl. X., fig. iv. l. m. n.)—The first of these arises from the fourth, fifth, and sixth; the second from the whole seven; and the third from the fifth and sixth cervical transverse processes, by as many tendons, which are connected with each other; they descend muscular, and are inserted tendinous, the first two into the upper edge of the first rib and at a little distance apart, and the third into the upper edge of the second rib near the spine. *Use.*—In general they are mere suspendors, but in very difficult respiration forcibly raise the top of the chest. As the weight of the chest is constantly hanging on them, they assist materially in preserving the erect position of the neck; but if the Muscles on either side act alone, they draw the neck forwards and downwards to that side.

2. The *Elevating Muscles* of the Ribs consist of twenty-six pairs, of which there are twenty-four pairs of

M. Intercostales, which run from the edge of one to that of another rib; these, according to their situation upon the outer or inner plane of the chest, are called *Intercostales Externi* and *Intercostales Interni;* the *former* of these arise from the whole under edge of the upper eleven ribs, and their short fibres pass downwards and forwards to the upper edge of the rib below, as far as the cartilage; whilst the *latter* commence close to the breast-bone from the under edge of the cartilage, and from the under edge of each of the upper eleven ribs, continuing as far back as their angles; their fibres pass backwards and downwards to be inserted into the edge of the rib below, and in so doing cross the external layer. *Use.*—By the contraction of both sets of Muscles the space between the ribs is diminished, and the cavity of the chest consequently shortened, but expanded laterally in proportion.

M. Levatores Costarum are usually described as separate Muscles, but are really only the beginning of the origins of the External Intercostal Muscles, from the transverse processes of the dorsal vertebres, by tendinous slips. Their insertion is similar to that of the External Intercostal Muscles.

M. Serratus Posticus Superior is a broad fleshy Muscle, covered by the blade-bone and its Muscles, arising by a thin tendon from the lower three cervical and the upper two dorsal spines, and is inserted by finger-like slips into the outside of the four ribs following the first. *Use.*—To elevate the ribs.

The *Diaphragm* or *Midriff* separates the belly from the chest, and forms a movable floor upon which the

heart principally rests, capable of elevation when expiration is performed, and of descent on inspiration. It is commonly divided into two portions: the superior or greater portion arises by fleshy slips from the back of the ensiform cartilage, and from the inside of the lower six pairs of ribs near their cartilages, also by four tendinous slips, which, soon becoming muscular, coalesce to form the legs or inferior and lesser portion; all the fibres ascend upwards and inwards towards a middle heart-shaped tendon, into which they are inserted. The legs, in their ascent, are separated by a space close to the spine, through which the aorta passes, and then interweaving with each other form a second hole in the muscular expansion on the left side, through which the gullet passes, whilst a hole in the tendon transmit the *Vena Cava Inferior* from the belly and the chest. *Use.*—When the diaphragm contracts, its middle tendon is drawn down, and the vaulted form which the muscle possesses when at rest becomes converted nearly into a flat plane, and consequently the capacity of the chest is increased vertically; whilst the diminution of its lateral extent, which might be supposed likely to occur from the considerable origin of this Muscle from the ribs, is prevented by the intercostal and inferior scalene Muscles.

3. The *Depressing Muscles* are

M. Serratus Posticus Inferior (Pl. VII., XXIV.), which arises by a broad thin tendon from the last two dorsal and the upper three lumbar spines; it is inserted by finger-like slips into the outer and back part of the lower four ribs. *Use.*—To antagonize the last and to depress the ribs.

M. Depressores Costarum arise from the upper edge of one, and inserted into the lower edge of the rib but one above it, upon the inner plane of the chest. *Use.*—Implied in its name.

M. Sterno-costalis is placed on the back of the breastbone, from the ensiform cartilage and second piece of which it arises, passes shortly upwards and outwards, and is inserted into the cartilages of the third and two following ribs. *Use.*—It restores the position of the cartilages by bringing them down after eversion during inspiration.

Of the Muscles of the Trunk.

The Spine, although capable of preserving its own virtually erect posture without other aid than the ligaments and elastic substances by which its pieces are connected together, is yet unable to support it by these means alone when the large cavities of the Chest and Belly appended in front of it are continually by their weight tending to bend it forwards. In order, therefore, to preserve the Trunk erect, and to steady the Spine so as to render it the fixed point upon which the motions of the Chest and Head, and indeed also of the Upper Limbs, are performed, as well also for the performance of those motions between the several pieces of the Spine which are necessary for preserving the equilibrium of the body in the varied and varying motions which are performed both by body and limbs, a great number of Muscles are placed upon the back of the Vertebral Column in order to counteract the disposition to bend forwards constantly operating upon it by the weight of the Chest and Belly. How great this disposition is, a comparison of the number of Muscles situated on the back, and erecting or extending the Spine with those placed in front which bend it forwards, will immediately indicate. All these Muscles are in pairs, and the two Muscles of a pair perform either extension or flexion of the Spine and Trunk according to their position; but if only one Muscle of the pair act, it sways the body to its own side forwards or backwards, as may be. It is also further to be observed, that the erect position of the Trunk now adverted to is only with reference to the pelvis; its support in that position upon the Thigh-bones will be considered hereafter in describing the Muscles passing from the Trunk to the Lower Limbs.

The three pairs of Muscles which specially preserve the erect position of the loins and back upon the pelvis are commonly called the Sacro-lumbar Mass, and consist of the following:—

M. Sacro-lumbalis (Pl. VII., XXVII.) is the outermost of this mass, and springs from the back and spines of the rump-bone, from the posterior spines of the hip-bone, and from the transverse and spinous processes and vertebral arches of all the vertebres of the loins in common with the next Muscles, and also by six or eight fleshy slips usually called *Musculi ad Sacro-lumbalem Accessorii*, from as many of the lower ribs; it ascends upon the back of the chest, and is inserted by long thin tendons into the angles of all the ribs. *Use.*—Besides the general action already described, it pulls down the ribs, and is, therefore, a Muscle of expiration.

M. Longissimus Dorsi (Pl. VII., XXVI.), situated on the inner side of the preceding, and having the same origin; it is more bulky, and is inserted into all the dorsal transverse processes by small double tendons, and by tendinous and fleshy slips into the upper ten ribs near their tubercles. *Use.*—Similar to the last mentioned.

M. Spinalis Dorsi (Pl. VII., XXV.) is the third and smaller Muscle of the Sacro-Lumbar Mass, and situated close upon the ridge of the Spine, arising from the Spinous processes of the upper two lumbar and lower three dorsal Vertebres by as many tendons; it is largely composed of tendinous cords, and is inserted by tendons into the spinous processes of the uppermost nine dorsal Vertebres below the first.

The remaining Muscles connected with the Spine are attached to one or other or all its different regions.

The two following sets are extensors if they act in pairs, or incline the Spine to that side, if acting singly.

M. Multifidus Spinæ, which lies in the groove between the transverse and spinous processes, arises from the back of the rump-bone, from the posterior spines of the hip-bone, from the transverse processes and arches of all the vertebres, to the fourth cervical inclusive, by as many tendons, which soon become muscular, and ascending obliquely upwards are inserted by tendinous slips into the spinous processes of all the Vertebres, except the first of the Neck.

M. Interspinales are little Muscles placed between the points of the spinous processes of all the vertebres except the first and second cervical; they are most distinct in the Neck.

All the other Muscles, if they act in pairs, are extensors, and at the same time prevent the lateral swaying of the Spine by bracing it up like the shrouds of a ship's mast, but if they act only on one side, they incline the Spine above their origin to their own side.

M. Quadratus Lumborum (Pl. VIII., fig. I.), of

Anatomy. a square shape, as its name implies, arises from the posterior spines of the hip-bone, and from the hind part of its crest, and is inserted into the transverse processes of all the lumbar vertebres, by a short tendon into the body of the last dorsal vertebre, and into the lower edge of the last ribs. *Use.*—Besides its action upon the Spine, it draws down the ribs, and is therefore a Muscle of expiration.

M. Semi-spinalis Dorsi arises from the transverse process of the tenth and three superjacent dorsal vertebres, tendinous and fleshy, and is inserted into the spinous processes of the upper four dorsal and lower two cervical vertebres.

M. Semi-spinalis Colli originates tendinous from the upper six dorsal transverse processes, becomes fleshy, and again tendinous as it is inserted into all the cervical spines except the first and last.

Along the outer margins of the Cervical Spine a pair of Muscles are placed analogous to the *M. Quadratus* of the loins, viz.—

M. Transversalis Colli, which originates from the upper five dorsal transverse processes, and is inserted into all those of the Neck excepting the last and first. *Use.*—If both Muscles operate they act like shrouds; but if only one, it draws the Neck towards that side.

Its junction is also assisted by the

M. Inter-transversales, which pass from the upper edge of one to the lower edge of another transverse process throughout the whole length of the Spine, except between the second and first of the Neck.

The Muscles which bend the Spine itself forwards are generally but two, and sometimes three pairs; but of these, one pair, the *M Psoæ Magni*, are strictly Muscles of the Lower Limbs, and the other two only proper flexors of the Spine. Of these the lower pair are

M. Psoæ Parvi (Pl. VIII., fig. I.), which are often wanting; they arise tendinous from the sides of the brim of the pelvis, ascend on the inner and fore part of the Great Psoas, and are inserted into the sides of the bodies of the upper two lumbar and sometimes of the last dorsal vertebre. *Use.*—They bend the loins upon the pelvis.

M. Longus Colli, upon the Neck, arises from the sides of the bodies of the upper three dorsal, and from the transverse processes of the sixth to the third cervical vertebres inclusive, and is inserted by tendinous and fleshy slips into the fronts of the bodies of all the cervical vertebres. *Use.*—It bends the Neck forwards on the Spine.

Flexion of the Spine is, however, more extensively, though less directly, performed by the three largest of the five pairs of Muscles forming the walls of the belly, which are attached to the Chest and act upon the Spine through it. Of these, the most efficient is,

M. Rectus Abdominis (Pl. VI., w.), which extends from the pelvis to the chest along the front of the belly, enclosed in a tendinous sheath to be presently noticed; it arises by a strong flat tendon to the inner side of the spine of the share-bone, soon assumes a broad flattened muscular form, ascends, and is inserted into the cartilages of the fifth, sixth, and seventh ribs. Its length is divided by two or three and a half tendinous intersections, rendering it a three or four-bellied Muscle. *Use.*—It draws down the front of the chest, and is, therefore, a Muscle of expiration, and, continuing its action, bends the Spine forwards upon the pelvis. It also compresses the bowels, and its tendinous intersections are generally said to be for the purpose of enabling portions of it to act separately; it would seem, however, more probable that the purport of this division is to render the Muscle more powerful and less liable to rupture. The sides of the belly are formed of three pairs of Muscles, two of which, besides acting as compressors of the abdominal contents, draw down the ribs, and are, therefore, both Muscles of expiration and flexors of the Spine, but the third pair compresses the bowels alone. Anatomy.

M. Obliquus Externus Descendens Abdominis (Pl. VI., v.) arises by as many finger-like heads from the eight lower ribs which run between the similar heads of the *M. Serratus Magnus;* in front it intermingles with the *M. Pectoralis Major*, and behind is overlapped by the *M. Latissimus Dorsi;* it passes downwards and forwards as a broad expanded Muscle, which is inserted below fleshy into the outer lip of the hip-bone; and from the superior anterior spine of the hip-bone up to the cartilage of the seventh rib it sends out a broad tendon, which, passing in front of the last described Muscle, joins its fellow between that pair from the ensiform cartilage to the junction of the share-bones, forming a middle line called the white line, *linea alba*, and the part attached to the spine of the hip-bone, and becoming tendinous passes across the femoral vessels connected with the broad sheath of the thigh, and with it forming the *crural arch* as it proceeds to be fixed in the spine of the share-bone, and turning outwards runs a short distance on the body of that bone to form a triangular attachment commonly called *Gimbernat's Ligament.*

In the broad expanse of tendon from this pair of Muscles covering the front of the belly, it is usual to speak of certain lines, 1st. The Semi-lunar Lines (*lineæ semilunares*), which mark the termination of the fleshy parts of these Muscles, the concavities of which face inwards towards each other; 2nd. The White Line (*linea alba*), formed by the junction of the two tendons in the middle of the body between the *M. Recti Abdominis;* 3rd. The Transverse Lines (*lineæ transversales*), which are connected with the tendinous intersections of those Muscles.

Three large and important apertures are also found in this conjoined tendon in the middle of the white line, the Navel or Umbilical aperture (*umbilicus*), through which the placental vessels of the mother have passed into the belly of the fœtus; and the two external abdominal rings, lengthened triangular apertures, above and to the inner side of each pubic spine, and formed by the attachment of one portion of the external oblique tendon to the spine and another to the symphysis pubis, which portions are called the outer and inner columns of the ring, through which the Spermatic vessels pass from and to the belly and testes.

M. Obliquus Internus Ascendens Abdominis, within the last Muscle, arises fleshy from the upper outer half of the crural arch, and from the whole lip of the hip, tendinous also from the tendinous origin of the

M. Latissimus Dorsi, its fleshy fibres spread out like a fan; the posterior are inserted fleshy into the cartilages of the lower six ribs, and into the ensiform cartilage, whilst the anterior fibres terminate in a tendon at the semi-lunar line, and then splitting into two layers include the *M. Rectus*, and terminate in the white line, the front layer being closely connected with the tendon of the External Oblique and the back layer with

that of the Transverse Muscle. *Use.*—This and the last pair of Muscles, although their fibres run in contrary directions, have the same action upon the chest, viz., pull it down, and are, therefore, Muscles of expiration, and, continuing their effort, bend the Spine with it. One of each pair of Muscles acting on the same side inclines the Chest and Spine in that direction.

M. Transversalis Abdominis placed within the last Muscles, arises fleshy from the insides of the lower seven ribs, by a broad tendon from the last dorsal and the upper four lumbar transverse processes, and fleshy from the upper outer half of the crural ring; its fleshy fibres pass forwards from behind to before, and at the semi-lunar line send out a tendon which, passing behind the posterior layer of the Internal Oblique tendon, is inserted with it.

The last pair of Abdominal Muscles, which are often wanting, are merely compressors of the bladder.

M. Pyramidalis (Pl. VI., x.), which arises from the share-bone near its junction with its fellow, rises upwards, narrowing as it ascends, and is inserted into the white line midway between the pubes and navel.

Of the Muscles of the Lower Limbs.

The Muscles of the Lower Limbs consist of sixty-one pairs, of which twelve arise from or cover parts of the Basin, and operate upon the Thigh; seven arise from or run along the Thigh, and act upon the Leg; ten arise from the Leg, and are attached to the Foot or Toes; and nineteen from the Foot, which are connected either with the Tarsal, Metatarsal, or Toe-bones.

All the Muscles of the Lower Limbs are included in tendinous sheaths or *fasciæ*, as they are called anatomically. Of these, the principal are the *Fascia lata*, or Broad Sheath of the Thigh, the Anterior Tibial Sheath, and the Plantar Sheath.

The tendinous insertion of the external layer of the Abdominal Muscles stretches from the superior anterior spinous process of the hip-bone to the spine and symphysis of the share-bones; and, unconnected with the Basin except at those points, leaves a considerable space between it and the body of the share-bones through which some muscles, vessels, and nerves pass into the thigh, over which it expands like a flat bridge, and hence bears the name of the *Crural Arch*, a part of great importance in reference to Surgical Anatomy. From this Crural Arch commences

The *Broad Sheath.*—It originates by a very sharp point a little to the outside of the spine of the share-bone, becomes wider as it passes outwards, and expanding over the whole thigh down to the knee, upon which it is lost, it dips in among the Muscles at the back of the thigh, and is attached to the linea aspera. But that already mentioned is not the whole of its attachment; for after having reached nearly the middle of the front of the hip-joint, it turns suddenly inwards and upwards, forming an edge like a sickle, which for that reason is called the *falciform process;* and then ascending, is fixed to the sharp edge of the body of the pubic bone above the thyroid hole, and continuing its attachment inwards, runs along the edge of the branches of the share and haunch bones down to the tuberosity of the latter, where it becomes confounded with the Great Gluteal Muscle. In this way a large aperture, the *Crural Ring*, is formed in front and to the inner side of the hip-joint, of which the outer anterior part is formed by that portion of the sheath connected with the Crural Arch, and the inner posterior by that attached to the body of the share-bone. Processes are sent towards the linea aspèra from the inside of the Sheath, which divide its interior into three distinct cavities, as is proved by the pus contained in fascial abscess of the thigh not being generally diffused amongst all the Muscles covering it, but only in one or other cavity as may be. One of these cavities includes all the extensor Muscles of the leg on the front of the thigh; a second envelopes those on the inner side, which adduct the thigh; and the third behind surrounds the flexor Muscles of the leg. The use of this Sheath is to keep the Muscles together, and whilst it renders the form of the limb more comely, by preventing them dangling loosely when unemployed, it also strengthens them, and increases their power in action by bringing their fibres more closely together, a physiological fact which is well known to common people, who, when preparing themselves for muscular effort, tightly bandage the limb more particularly to be called into action, as they justly say, to increase its strength. For this purpose, also, the Sheath is furnished with a proper Muscle, the

M. Tensor Vaginæ Femoris (Pl. VI., τ; Pl. VIII., fig. 1.*), which, arising fleshy and tendinous from the superior anterior spinous process of the hip-bone, passes backwards and downwards, to be inserted into the sheath a little below the great trochanter of the thigh-bone. *Use.*—Besides tightening the Sheath it rotates the thigh inwards, and it is remarkable as being one of the only two Muscles by which that motion is performed.

The Muscle which bends the thigh upon the trunk, and is, therefore, the first agent in progression by raising the leg from the ground, is commonly described as two, the *M. Psoas Magnus* and the *M. Iliacus Internus.* It would be far better, however, to consider it, as it is in fact, a bicipital or two-headed Muscle, and call it the

M. Vertebro-Iliacus (Fig. 1. a. a.).—Its *long head* arises from the side of the bodies, and from the transverse processes of the last dorsal, and of all the lumbar vertebres; and these several slips uniting together form a large belly, which descends along the brim of the pelvis, and becomes tendinous as it passes behind the Crural Arch. Its *short head* originates from the whole belly of the hip-bone, and its fibres running inwards and downwards unite with the tendon of the long head, and pass with it behind the Crural Arch, obliquely across the fore and outer part of the capsule of the hip-joint, to be inserted into the inner and back part of the less trochanter, enveloping in its course the whole of that process. *Use.*—Besides flexing the thigh on the trunk it twists it outwards; but if its action be reversed by both feet being kept on the ground, it bends the trunk on the lower limbs; or if one muscle only be exerted, it twists the body inwards upon the thigh.

The principal antagonist to this Muscle, and by which the thigh is extended or brought back upon the trunk, is found on the back and lower part of the pelvis, and covering the greater part of the outlet. It is the largest Muscle in the body, and is called the

M. Gluteus Maximus (Pl. VII. xxxix.; Pl. VIII., fig. 11. b.). It arises from the back of the posterior spinous processes of the hip-bone, from the back of the rump-

Anatomy. bone, from the coccygeal bone, and from the sacro-ischiatic ligaments, over the inner edge of which it is folded. It consists of numerous bundles of fibres, which are loosely connected but together form a very wide and thick Muscle. These pass outwards and downwards, collecting into a very strong, wide tendon, which runs over the back of the great trochanter, and descends to be inserted below it into the upper outer limb of the linea aspera for nearly one-third of the length of the thigh, and is confounded with the broad sheath. *Use.*—Besides extending the thigh, it twists it outwards upon the pelvis; but if the foot be fixed on the ground, and only one Muscle acts, it twists the trunk backwards upon the thigh. The principal use of this Muscle, however, is to preserve the erect position of the trunk upon the Lower Limbs, and it is for this reason that in Man it is larger than in any other animal; and hence arises that peculiar fulness of the buttock in the human subject which is found in him alone throughout the whole of the Animal Kingdom. In every position and motion of the body on the lower extremities, or of them upon the body, it is called into action, except in the recumbent posture; for even in sitting it counteracts the slight tendency to falling forwards which still exists, though not to the same extent as when the body is erect. Between this great Muscle and the back of the pelvis, and partially covering one another, are six Muscles, all of which, excepting one, tend to twist the thigh outwards even when at rest; and by so doing turn the toes outwards, and increase the base of support afforded by the feet. They also draw the head of the thigh-bone tightly into the hip-socket, and antagonize other strong Muscles, presently to be mentioned, which draw the thigh inwards, and steady the pelvis upon the lower limbs.

The largest two of these Abducting Muscles, as they are called, are placed entirely on the back of the pelvis. The first is the

M. Gluteus Medius (Pl. VIII. fig. II. c.), which arises from all the back surface of the hip-bone above the semicircular ridge, which, beginning from the superior anterior spine, and running into the ischiatic notch, it collects into a stout tendon, which is inserted into the outer and back part of the great trochanter of the thigh-bone.

M. Gluteus Minimus (Fig. III., d.) arises below the semicircular ridge on the back of the hip-bone, descends into a short stout tendon, which is inserted into the fore and upper part of the great trochanter.

The former of these Muscles twists the top of the thigh-bone outwards, whilst the latter assists the *Tensor Vaginæ* to twist it inwards.

Below the Least Gluteal Muscle, a slender Muscle is seen emerging from the cavity of the pelvis, through the great sacro-ischiatic notch. This is the

M. Pyriformis (Fig. IV. and III. e.), which originates from the front of the middle three pieces of the rump-bone by as many slips, which coalesce; and, forming a single flattish Muscle, pass from the pelvis, sending out a long slender tendon to be inserted into the top of the trochanteric pit.

Through the little sacro-ischiatic hole another flat tendon is seen emerging from the pelvis. It is that of the

M. Obturator Internus (Fig. IV., f.), which, arising from the whole margin of the thyroid hole, and the back of the ligament by which it is filled, descends to pass out of the hole, forming a tendon to be inserted into the trochanteric pit below the last Muscle, but separated from it by the upper head of the next Muscle,—the

M. Gemini (Figs. III. and VI. g.), which arises from the spinous process, and the lower head from the tuberosity of the haunch-bone. The two heads run horizontally outwards, enclosing between them the tendon of the last Muscle, and are inserted with it into the lower part of the trochanteric pit.

Below the last Muscle is another of a square shape, and hence called the

M. Quadratus Femoris (Fig. III. and V. h.), which arises from the outside of the ischiatic tuberosity, and passing outwards is inserted into the quadrate line, between the two trochanters.

If its upper edge be turned down, the tendon of another abducting Muscle, the

M. Obturator Externus (Fig V. i.) is seen. It arises from the margin of the thyroid hole, and from the front of the thyroid ligament. Its fibres pass downwards and outwards, collect into a tendon which runs between the lower edge of the acetabulum and the ischiatic tuberosity outwards and backwards, to be inserted into the trochanteric pit just below the *M. Gemini.* Its *Use* is similar to that of the preceding Muscles.

The Adducting Muscles which antagonize those just described consist of a large mass occupying the inside of the thigh, and forming two Muscles, one single and one three-headed Muscle.

M. Pectineus (Fig. I. j.).—This arises on the upper inner part of the thigh, from the front of the body of the share-bone, passes outwards and downwards, and is inserted by a broad flat tendon into the upper inner part of the linea aspera.

M. Triceps Adductor Femoris (Fig. V. k.).—This very large Muscle forms the principal fleshy mass upon the inside of the thigh, from the pubic symphyis and arch to the knee. It consists of three portions—the *long one*, arising by a rounded tendinous head from the upper part and symphysis of the share-bone; the *short one* from the front of the branch of that bone; and the *large one* from the same branch, and from the ischiatic branch and tuberosity, by a very fleshy and extensive origin. The three portions may be readily distinguished, and though their tendons become ultimately confounded, they are said to be inserted—the *large portion*, tendinous, into the whole length of the linea aspera, and by a rounded tendon into the inner condyle, and the other two also into the linea aspera in front of the former by flat tendons, the *long portion* into the middle, and the *short one* above it, and into the little trochanter behind the *M. Pectineus.*

When the feet are firmly fixed to the ground, and both the just-mentioned Muscles of both limbs, especially the latter, act, they fix the pelvis and prevent it swaying to either side precisely in the same manner as the mast-head of a ship is stayed. If one foot only rest on the ground, these Muscles pull the pelvis downwards and slightly backwards on that thigh; but if the Muscles of the elevated limb act, they bring the thigh upwards, inwards, and forwards, turning the knee outwards at the same time on the supporting limb. If parts of these Muscles act, the *M. Pectineus* will bring the thigh inwards and forwards, and the *large portion* of the *M. Triceps* inwards and backwards.

The other Muscles of the thigh are seven in number, all acting upon the leg, but some of them connect the leg directly with the pelvis.

M. Quadriceps Extensor Cruris.—(Pl. VI. B. C. D.)—This is most commonly, though not very properly, described as four distinct Muscles, by the names of *M. Rectus*, *Vastus Internus* and *Externus*, and *Crureus;* really, however, they form but one four-headed Muscle, occupying the front and sides of the thigh. The *long head* (*M. Rectus*) arises by two short tendons, not exceeding an inch in length, the one from the inferior anterior iliac spine, and the other from the back of the hip-bone just above the hip-socket; they soon unite into a very strong tendon, which, passing downwards towards the front of the thigh, bellies out into a large and powerful Muscle, occupying the middle three-fifths of the limb, and becomes tendinous below. The *short head* (*M. Crureus*) commences its origin immediately below the ridge, running in front from one trochanter to the other, and continues arising from the whole front of the thigh-bone nearly as low as the articular surfaces on the condyles, whence it runs into the back and lower part of the tendon of the long head. The *outer head* (*M. Vastus Externus*) is a very enormous muscular mass arising tendinous and fleshy from the fore and outer part of the root of the great trochanter, from the whole outer edge of the linea aspera, and below becomes partially confounded with the short and long heads. The *inner head* (*M. Vastus Internus*) commences from the front of the root of the less trochanter, and continues arising from the whole length of the inner edge of the linea aspera; its fibres pass forwards, and at the lower part are confounded with the long and short heads. The coalition of the lower ends of these four muscular pieces forms a broad tendon, which is inserted into the base and sides of the knee-cap, the stoutest and thickest part being formed by the long and short portions which are connected with its base, whilst the inner and outer form thin tendinous expansions which spread upon the fore and lateral parts of the knee-joint prior to their insertion into the knee-cap. *Use.*—The principal and most important action of this Muscle is to extend or straighten the leg upon the thigh, whilst its long head may or may not at the same time flex the whole limb upon the trunk; it is therefore a very important Muscle in progression by carrying the leg and foot forwards, when the limb is raised from the ground; but if the foot be fixed, its tendency is to pull the trunk forwards upon the thigh by its long head. It is also the Muscle by which we are raised from the sitting to the erect posture, the action then commencing from the insertion instead of the origin of the Muscle.

The antagonists to this large Muscle are four, situated on the back of the thigh, extending, all excepting one, between the ischiatic tuberosity and the leg.

M. Semi-tendinosus (Pl. VII., XLII; Pl. VIII., fig. VI. m.) originates from the back and upper part of the tuberosity by a tendon in common with another Muscle, descends some little distance, and then forms a large muscular belly, which, as it passes down the back of the thigh, inclines towards the inside, and throws out a tendon which, passing behind the inner condyle and around the head of the tibia, is inserted by a broad expansion into the inner and fore part of that bone opposite the tubercle. *Use.*—It bends the leg upon the thigh and extends the thigh upon the pelvis; if the other leg be lifted from the ground, it also pulls the pelvis a little downwards towards the thigh.

M. Semi-membranosus (Pl. VII., XLIII.; Pl. VIII., fig. VI. n.)—though thus named, is more tendinous than the preceding, it arises from the back and under part of the ischiatic tuberosity by a flat tendon, which, in the middle of the thigh, forms a short but bulky muscular belly, and through the lower third again becomes tendinous, and its flat tendon accompanying that of the preceding behind the inner condyle is inserted into the back of the head of the tibia. *Use.*—Similar to that of the last.

M. Biceps Flexor Cruris.—(Pl. IV., XLI.; Pl. VIII., fig. VI. o.)—The *long head* of this double-bellied Muscle arises from the ischiatic tuberosity in common with the *M. Semi-tendinosus*, descends a short distance, and then forms a fleshy belly which passes down along the outside of the thigh, and just above the outer condyle forms a flat tendon receiving the *short head* which arises from the outer lower third of the linea aspera; the joint tendon passes behind the outer condyle, forms the outer hamstring, and is inserted into the process at the top of the fibula. *Use.*—It bends the leg upon the thigh, extends the thigh upon the pelvis, and, if the other leg be raised from the ground, tilts the pelvis rather outwards and backwards.

The fourth flexing Muscle is short, and acts only upon the leg and thigh; it is situated on the back of the knee-joint, and called from this circumstance

M. Popliteus.—(Pl. VIII., fig. VII. p.)—It arises by a short strong tendon connected with the posterior ligament of the knee-joint from the inside of the outer condyle, becomes fleshy as it passes inwards across the ligament, expands as it descends, and is inserted into the back of the head of the tibia, above the linea poplitea. *Use.*—It only flexes the leg on the thigh, or the thigh on the leg.

Two other Muscles stili remain undescribed upon the thigh.

M. Gracilis—(Fig. VI. q.) a delicate flat Muscle—arises by a broad, thin, tendinous origin from near the pubic symphysis, it continues down the inside of the thigh as a long thin flat Muscle, which behind the inner condyle sends a delicate tendon to be inserted into the inner and fore part of the head of the tibia below its tubercle, and covered by the insertion of the following Muscle. *Use.*—It principally serves to draw the leg inwards towards its fellow, and thus assists the great Adducting Muscles.

M. Sartorius.—(Pl. VI., W.; Pl. VIII., fig. I. r.)—This is also a flat muscle, and is the longest in the body; it originates from the superior anterior spine of the hip-bone, in company with the *M. Tensor Vaginæ*, soon becomes fleshy, runs downwards, forwards, and inwards to the lower third of the thigh, whence it passes behind the inner condyle, becomes tendinous, winds round the head of the tibia, then expands and forms a broad tendon, which is inserted below the tubercle, covering the insertions of the *M. Gracilis* and *Semi-tendinosus*. *Use.*—It flexes the leg and thigh upon the pelvis, and at the same time draws the knee forwards and upwards so as to cross the opposite thigh, producing the position called sitting cross-legged, which, being usually employed by tailors, has given rise to its name.

The Muscles on the front of the Leg are covered by a tendinous expansion, called

The *Anterior Tibial Sheath*, which commences above from the rim of the outer hollow of the shin-bone, and from the front of the head of the splint-bone; it passes down the front of the leg, is connected on the inner side with the whole spine of the shin-bone, and on the outer side, dipping between the Common Long Extensor of the Toes and the Peroneal Muscles, is attached to the front ridge of the splint-bone; at the lower part of the leg it is continued from one ankle to the other, and there commonly, but improperly, called the *Transverse Ligament of the Ankle;* it is continued on the instep, where it is ultimately lost in the cellular tissue of that part.

The Muscles which form the fleshy parts of the Leg may be arranged into two sets: 1st, those which operate upon the foot alone; 2nd, those which act directly upon the toes, and intermediately upon the foot; of the former there are *six*, and of the latter *four* to each foot, and they are placed in relation to each other as follows,—upon the front and side of the leg five, and on its back five.

Upon the front and next to the shin-bone, in the outer hollow surface of which it lies, is the

M. Tibialis Anticus.—(Pl. VIII., fig. VIII. s.)—This arises from the outer under part of the head of the shin-bone, and from the upper two-thirds of its outer surface, from the fore and inner part of the interosseous ligament, and from the inner surface of the crural fascia; the fibres thus derived terminate in a strong tendon which passes down in front of the base of the bone, inclines inwards over the instep, and is inserted into the inside of the inner cuneiform and of the base of the metatarsal bone of the great toe. *Use.*—It bends the foot upon the leg, at the same time inclining its inner edge upwards.

To the outer side of the just-named Muscle is the

M. Extensor Longus Digitorum Pedis (Fig. VIII. t.), which, commencing from the under outer part of the head of the shin-bone, close to the origin of the last Muscle, arises also from the whole length of the front of the splint-bone, and from the interosseous ligament; its fibres run downwards and forwards into a tendon, which, passing over the outer and fore part of the ankle-joint, continues on the instep and divides into four tendons, which, spreading over the upper surfaces of the outer four toes, are inserted on their extreme phalanges. *Use.*—It extends or elevates the toes upon the upper surface of the foot, and, if its action be continued, bends the foot upwards upon the leg.

Covered by the last Muscle is the

M. Extensor Proprius Pollicis (Fig. VIII. u.), which arises from the inner and fore part of the two lower thirds of the shin-bone, and from the interosseous ligament; its fibres run inwards and forwards into a tendon, which, passing over the front of the ankle, runs across the instep inwards, along the upper surface of the great toe, and is inserted into its second piece. *Use.*—It extends the great toe upon the foot, and bends the foot upon the leg.

Upon the upper or dorsal surface of the foot is the

M. Extensor Brevis Digitorum Pedis (Fig. IX. v.), which, originating from the fore and outer surface of the heel-bone, runs inwards and forwards over the instep, dividing into four delicate bellies, which send out each a tendon to be inserted into the first row of bones of the inner four toes. *Use.*—It merely extends the toes upon the foot.

On the outside of the Leg are two Muscles, the

M. Peronei (Fig. VIII. w. x.).—One of them, the *M. Per. Longus*, arises from the head and from the outer upper half of the splint-bone, it descends and gives off a long and strong flat tendon, which passes behind the outer ankle in a groove; the other, the *M. Per. Brevis*, originates from the lower outer half of the splint-bone, and also sends out a strong flat tendon which passes behind the outer ankle, and to this point it is covered by the long Muscle and its tendon. A little below the ankle the two tendons separate; the long tendon enters the groove in the under surface of the cuboid bone, crosses the sole of the foot close to the tarsal bones, and is inserted into the inner under part of the inner cuneiform bone and the base of the tarsal of the Great Toe, just below the insertion of the Anterior Tibial Muscle. The short tendon runs forwards along the outer margin of the foot, and is inserted into the base of the metatarsal bone of the little toe. *Use.*—The primary use of these Muscles is to elevate slightly the outer margin of the foot, to assist in extending the foot upon the leg, and when extending to rotate the foot outwards upon the ankle-joint. But the Long Peroneal Muscle serves a much more important office, assisted by the Anterior Tibial Muscles, for these two Muscles preserve the lateral arch of the foot when that member rests upon the ground, and when in stepping forward the weight of the body is thrown upon the foot; in consequence of the close insertion of these two Muscles, their tendons act as an elastic sling upon which the middle of the foot rests, and thus materially assist the great Muscles of the calf of the leg and those belonging to the toes, which are more commonly described as bearing the weight of the body.

The Calf of the Leg, as it is commonly called, consists of two very large and muscular bellies, which join together below in a very powerful tendon, commonly called the *Tendo-Achillis;* these two bellies are usually described as distinct Muscles, and are called the external and internal, but it is really only a three-headed Muscle, and may therefore be named only the

M. Gastrocnemius.

The *outer* or *posterior belly* (Pl. VII., XLVII.) is the largest: it commences by two tendinous and muscular origins above the back of the tibial articular surfaces, on the condyles of the thigh-bone, and firmly connected with the posterior ligament of the knee-joint, upon the back of which they pass separately, increasing in size and approximating as they descend, till at last they coalesce and form the large broad muscular mass specially called the Calf of the Leg; a sort of seam, however, indicates the distinction between the two pieces, which is rendered more distinct at their lower part, where a broad flat tendon is produced, the middle part of which ascends like a short narrow spear head to this seam.

The *inner* or *anterior* belly (Pl. VIII., x.) arises from the back of the head of the splint-bone, and from the upper outer half of the same bone, also from the shin-bone along the lower edge of the popliteal line beneath the insertion of the Popliteal Muscle; its surface is principally tendinous, and the muscular part diminishes as it passes down below the middle of the leg to join the tendinous expansion of the outer belly. The strong tendon arising from the junction of the bellies narrows as it descends, but increases in thickness from

behind to before, and is inserted into the upper and back part of the tuberosity of the heel-bone. *Use.*—If the foot be kept at its usual rectangular position when at rest, the outer belly bends the leg upon the thigh; but if that position is not preserved, both bellies at once extend the foot upon the leg; and if the toes be kept fixed upon the ground by other Muscles, it elevates the heel, and consequently raises the body from the ground. It is therefore the great antagonist of all the Muscles which bend the foot upon the leg, and of those which extend the leg upon the thigh.

A very delicate little Muscle, which has the longest tendon in the body, viz., the

M. Plantaris (Fig. VII. z.), commences by a small tendon from above the back of the outer condyle, forms a small belly running upon the back of the knee-joint, and as it descends into the leg sends off its slender tendon, which, passing between the two bellies of the Gastrocnemial Muscle, emerges from them below, and, running upon the inner margin of the Tendo-Achillis, is inserted into the inner and back part of the tuberosity of the heel-bone. *Use.*—Principally to turn the inside of the heel upwards, and also to assist in elevating the heel from the ground.

Beneath the last-mentioned Muscles the tendinous *Posterior Tibial Sheath* is observed, commencing from the lower edge of the popliteal line, and attached from the head of the splint-bone downwards along the whole length of its outer margin, and on the inner side throughout the whole length of the shin-bone, below the termination of the popliteal line, to the bottom of the leg; on the outside it becomes confounded with the sheath of the Peroneal Muscles behind the outer ankle, and on the inner side it is lost in the tendinous bridge which gives origin to the Abducting Muscle of the Great Toe. This sheath includes three Muscles, which lie close to the interosseous ligament and the bones. The middle and longest of these is the

M. Tibialis Posticus (Fig. IX. b.), which arises from the upper inner and back part of the splint-bone; from the back of the shin-bone below the popliteal line, and from a considerable part of the back of the interosseous ligament, towards the lower part of the leg; these fibres run into the middle tendon, which continues downwards, inclining inwards, and enters the groove at the back of the inner ankle, whence it passes into the foot close to the tarsal arch, to be inserted by several distinct slips into the under surfaces of all the tarsal bones, except the heel-bone; the slip to the navicular bone being the largest. *Use.*—It extends the foot upon the leg; also turns the inner edge of the foot upwards, and assists in supporting the transverse arch of the foot.

M. Flexor Longus Digitorum Pedis Perforans (Fig. IX. a.) is situated on the inner and back part of the leg; begins to arise from the back of the shin-bone at the lowest point of the popliteal line, continues its origin some way down, and then sends out a tendon, which at first runs along the inner edge of the tendon of the Posterior Tibial Muscle, but having reached the back of the ankle-joint crosses behind it, and entering the sinuosity of the heel-bone is continued into the middle of the sole of the foot, between the Interosseal Muscles above and the Short Flexor of the Toes below, where it receives a fleshy mass called the *M. Flexor Digitorum Accessorius* (fig. X. c.), which arises from the outer part of the astragalo-calcaneous ligament, and from the front of the heel-bone itself, and runs into the outer posterior edge of the tendon of the Long Flexor, which immediately divides into four slender tendons; these pass forwards to the outer four toes, and entering the digital sheaths perforate the tendons of the Short Flexor, and are inserted into the under surface of the tips of the extreme bones of the same toes. From the inner edge of each of these tendons, immediately after the division of the principal tendon, arises a small Muscle, in shape like a worm, and hence called *M. Lumbricales.* These send out each a small slender tendon, which spreads out and is inserted into the inside of the first bone of the corresponding toe, and run into the tendons of the Extensor Muscle. *Use.*—The Long Flexor Muscle is an important agent in progression; it bends the toes into the sole of the foot, and consequently grasps the ground, hooking the toes into it so as to make them the resisting point from which the body is jerked forward in procession; in which office it is materially assisted by the Short Flexor, hereafter to be described. In uncivilized people, by whom the foot is not mechanically confined, the action of these Muscles is much more extensive and powerful than among ourselves, whose feet are encased in shoes, which become greater impediments in proportion to the thickness of their soles. Another function of the Muscle is to extend the foot, and if the toes be fixed on the ground it helps to support the body on tiptoe.

The Accessory Muscle either assists the Long Muscle in grasping, at which time it may be accounted as a second head, or if the Long Muscle be inactive it operates upon its short tendons, which then serve the purpose of tendons to the Accessories. The Lumbricales incline the toes to which they are attached inwards.

M. Flexor Longus Pollicis (Fig. IX. d.) is situated on the outer edge of the Posterior Tibial, and is the most bulky and powerful of the deep Muscles at the back of the leg. It arises by two thick sets of fibres from the lower back and outer surface of the Splint-bone; these run into a middle tendon, which runs into the sinuosity of the heel-bone between it and the astragalo-calcaneous ligament, and having got fairly into the sole of the foot crosses above the tendon of the Long Flexor of the toes, and reaching the inner side of the foot passes on the under surface of the Metatarsal bone and the two bones of the great toe, to be inserted into the top of its second piece. *Use.*—It bends the Great Toe into the Sole, and is most important in progression; by it the Great is the first of the Toes which grasps the ground, and in consequence of the length of that member, as the foot and other toes are raised from the ground the whole weight of the body is ultimately borne upon it, till in the end it jerks the whole trunk forward. It also extends the foot upon the leg. But it mainly assists in supporting the transverse arch of the foot; for, passing through the sole from without inwards, it crosses the tendon of the Long Flexor of the Toes, which runs from within outwards: the result of this is, that whilst the latter draws the outside of the Sole inwards, the former draws the inside outwards, and thus the splaying out of the foot by the weight of the superjacent body is prevented. The crossing of the tendons of these two Muscles also forms a second kind of sling, not so perfect indeed as that of the Anterior Tibial and Long Peroneal Muscles, by which the weight of the body is in a measure divided between them, even when we stand on the great toe alone.

The tendons of the last described three Muscles, as well as those Muscles which are situated in the sole of the foot, are not visible till the removal of a large tendinous expansion, the

Plantar fascia, which originates by a thick mass from the under part of the tuberosity of the heel-bone; it consists of fibres, the greater number of which run lengthways upon the sole of the foot, but are connected by many which interlace transversely with them. Soon after its origin it divides into three portions, of which the *middle portion* is the thickest, strongest, and most extensive; it occupies the middle of the foot, and rather before the bases of the Metatarsal bones divides into five slips, which make their way towards the roots of the toes and become blended with the digital sheaths. The *outer portion*, which is also strong and thick, passes forward, becomes fixed to the tuberosity of the little Metatarsal bone, and is lost upon the Abductor and Short Flexor Muscles of the little toe. And the *inner portion*, which is very thin, then spreads over the short Muscles of the great toe and is lost upon them.

In the middle of the Sole, besides the Accessory Flexor and the Lumbrical Muscles, already described, is the

M. Flexor Brevis Digitorum Pedis Perforatus, which arises, in common with and between the Abducting Muscles of the Great and Little Toes, from the fore and under part of the tuberosity of the heel-bone, and also from the middle portion of the plantar fascia; it sends forwards four slender tendons, perforated by the tendons of the Long Flexor Muscle, and inserted into the under surface of the second phalanges of the four lesser toes. *Use.*—It assists the Long Flexor by bending the second phalanges into the sole, and helps to sustain the longitudinal arch of the foot.

Upon the inside of the Sole are three Muscles belonging to the Great Toe, the innermost of which is the

M. Abductor Pollicis Pedis (Fig. XI. f.), which arises fleshy from the inner and fore part of the heel-bone; as it passes forwards becomes tendinous, and is inserted into the outer sesamoid bone.

M. Flexor Brevis Pollicis Pedis (Fig XI. g.) arises to the outer side of the last Muscle from the Heel-bone by one head, and by another from the outer cuneiform bone; its two bellies pass one on each side of the tendon of the Long Flexor Muscle, and are inserted into the sesamoid bones of the Great Toe.

M. Adductor Pollicis Pedis (Fig. XII. k.) originates from the fore and under part of the heel-bone, from the outer cuneiform and from the cuboid bone; it forms a large fleshy belly, which is inserted tendinous into the outer sesamoid bone. *Use.*—If the former and latter Muscles act together they assist the Short Flexor in bending the first piece of the Great Toe upon the metatarsal bone; if separately, they abduct or separate from, or adduct or approximate to the other toes the whole Great Toe.

On the outer side of the Sole there are two Muscles belonging to the little Toe.

M. Abductor Minimi Digiti (Fig. XI. h.) arises from the under outer part of the tuberosity of the heel-bone, and from the plantar sheath, also from the base of the Metatarsal bone of the little toe; it is inserted into the outside of the first bone of that Toe.

M. Flexor Brevis Minimi Digiti (Fig. XI. i.) originates from the front edge of the groove in the cuboid, also from the base of the Metatarsal bone of the little toe; it is inserted into the base of the first bone of the same toe. *Use.*—If the last two Muscles act together they bend the little toe into the sole, but if the former act alone it separates the little from the other toes.

The heads of inner and outer Metatarsal bones are connected by a Muscle called the

M. Transversalis Pedis (Fig. XII. j.), which runs across from the outside of the head of the great Metatarsal, receives slips from each of the others as it passes outwards, and is finally inserted into the inside of the little Metatarsal bone. *Use.*—It approximates the heads of all the Metatarsal bones.

Besides the Muscles already described, there are some others called

M. Interossei (Fig. XII. l.), which occupy the spaces between the Metatarsal bones, whence they arise, and are inserted into the sides of the bases of the first row of the toe-bones. They are seven in number, four being called *External*, which are bicipital, or having two origins; and the other three *Internal*, which have but a single origin. *Use.*—To bring each toe inwards or outwards towards the side on which they are inserted.

Of the Muscles of the Upper Extremities.

The Muscles acting upon each Upper Extremity consist of fifty-four: of these eight connect the limb to the Trunk; nine, the Blade-bone to the Upper and Fore Arm; twelve, the Upper Arm to the Fore Arm, Hand, and Fingers; one, the bones of the Fore Arm to each other; six, the Fore Arm to the Hand and Fingers; and eighteen on the Hand connecting its several pieces.

Of the Muscles which connect the Upper Extremity to the Trunk, some are attached to the Shoulder-bones, and others to the Upper Arm.

Of those which connect the Trunk with the Shoulder-bones, three are situated on the back, one on the side, and two in front.

M. Trapezius (Pl. VII., III.), so named from its figure, is placed superficially on the back of the Neck and Chest; it begins by a thin fleshy origin from the great external transverse ridge of the occipital bone for about the space of an inch to the outside of its protuberance, also by a strong thick tendon from the protuberance itself, from which point to the sixth cervical spinous process it joins its fellow by cellular tissue, forming what is improperly called *ligamentum nuchæ*, a structure which, in the human body, does not exist; it arises also from the lowest two cervical and from all the dorsal spines excepting the lowest two or three; the upper fibres pass downwards and forwards, forming the outer marginal line of the Neck; the middle fibres run horizontally outwards, and the lower ascend. They are inserted into the upper outer third of the collar-bone, and into the inner edge of the acromion, and the upper edge of the spine of the blade bone. *Use.*—The upper fibres raise the collar and blade bones, or, as it is commonly called, "shrug the shoulders;" the middle fibres draw the blade-bone inwards towards the Spinal column, and the lower draw it downwards.

When the *M. Trapezius* is turned aside, two Muscles are seen,—

M. Levator Scapulæ (Pl. VII., XXI.), a long flat Muscle arising by tendinous slips from the uppermost five cervical transverse processes, but sometimes from fewer; it is inserted tendinous and fleshy into the

upper angle of the blade-bone, and into all that part of its base which is above the spine. *Use.*—It elevates this angle of the bone, and by so doing tilts the shoulder-joint downwards.

M. Rhomboideus (Pl. VII. xxii. & xxiii.), generally described as two Muscles, consists of an *upper narrow slip* and a *lower broad expansion*, the former arising from the two or three lower cervical, and the latter from the upper five dorsal spines by a thin delicate tendon; the fleshy fibres of the Muscle run out horizontally, and are inserted tendinous and fleshy, the upper into the base of the blade-bone opposite its spine, and the lower into the base below the spine. *Use.*—To draw the blade-bones together.

Upon the side of the Chest is placed a large broad Muscle, the

M. Serratus Magnus (Pl. VI., t. t. t.), so named from the saw-like appearance produced by the slips which originate from the nine upper ribs, and which mount upwards and backwards to be inserted along the whole anterior edge of the base of the blade-bone. *Use.*—To draw the whole base of the blade-bone forwards and rather downwards, antagonizing the *M. Rhomboideus* and *Levator Scapulæ*, and assisting in bringing the shoulder-joint forwards. The following two Muscles are covered by the *M. Pectoralis Major*, to be presently described.

M. Subclavius is of small size, arising by a tendinous origin from the first rib, close to its junction with the cartilage, lies beneath the clavicle, and is inserted into its middle third. *Use.*—It slightly depresses the collar-bone, but its real use is to serve as a muscular ligament by which that bone is firmly connected with the trunk, and greater extent of motion admitted than would be allowed by true ligament.

M. Pectoralis Minor is of an irregularly triangular form, its base facing towards the front of the chest, and its apex towards the shoulder; it arises from the three ribs below the second by tendinous and fleshy origins; its fibres collect, run upwards and outwards into a tendon, which is inserted into the coracoid process of the blade-bone. *Use.*—It pulls the shoulder-joint downwards and forwards, and thus antagonizes the *M. Trapezius*.

The two Muscles connecting the Upper Arm with the Trunk are the following:—

M. Pectoralis Major (Pl. VI., r.; Pl. IX., fig. ii. a.), situated in front of the Chest, and covering the *M. Sabclavius* and *Pectoralis Minor*, is a large triangular Muscle, which by its greater development characterizes the male chest, and by its extension into the Upper Arm forms the front boundary of the arm-pit. It arises fleshy from the inner under half of the collar-bone, from both pieces of the breast-bone, and from the cartilages of the fifth and sixth ribs; it covers the fore and upper part of the chest; its upper fibres pass down, its lower up, and the middle transversely outwards, collecting into a thick muscular mass in front of the arm-pit, and, extending to the Upper Arm, is inserted into the fore or outer edge of the bicipital groove. *Use.*—When the arm hangs down it draws it closer to the chest, and also across it and forward; if elevated, it pulls it down and forwards: and if it have been rotated outwards, it returns it to its natural position.

M. Latissimus Dorsi (Pl. VII. iv., Pl. IX., fig. ii. b.) is the most extensive Muscle in the body, and, like the last, of an irregularly triangular form, its base running along the lower part of the spine, its apex terminating in the Upper Arm, and as it passes from the Trunk forms the hinder boundary of the arm-pit; it arises tendinous from the spinous processes of the rump-bone and the hind part of the hip-bone, from the spinous processes of all the loin, and from four to seven of the lowest back vertebres, and by fleshy and tendinous slips from the lower four ribs; its fleshy mass spreads over the lower and lateral parts of the back and chest, collects as it passes upwards, runs over the back of the lower angle of the blade-bone, whence it is said to receive additional fibres, and then crossing the arm-pit terminates in a broad strong tendon, which is inserted into the inner or hinder edge of the bicipital groove of the upper arm-bone. *Use.*—When the arm hangs down it draws it closer to the side, also across and behind the chest; if elevated it depresses it; and if turned outwards rotates it inwards, assisting the last Muscle in that action, and perfecting it more completely.

Of the Muscles already mentioned, those which connect the Trunk with the collar and blade bones are specially for the purpose of fixing the socket of the shoulder-joint in such position as is most suitable for the performance of the various and varying motions there occurring, and at the same time to steady the socket, though altering its position as occasion may require; on which account it is that the motions of the Upper Arm are much more extensive upon the Trunk than those of the Lower Limb, in which the socket of the hip-joint cannot have its direction changed, from its connexion with the trunk being by such close and short ligaments as to render the hip and rump bones equivalent in this respect to a single bony ring. The other two Muscles which connect the Upper Arm to the Trunk have nothing to do directly with altering or fixing the shoulder-bones, though they do so indirectly, but have merely their connexion with the rump to increase their power by making them longer levers.

There are seven Muscles moving the Upper Arm directly upon the socket of the blade-bone (Pl. IX., figs. i. & ii.).

M. Deltoides (Pl. VII. v., Pl. IX. fig. i. a.) is the large Muscle covering the shoulder-joint, causing its roundness; it is of a triangular shape with its base upwards, and its basal angles bent towards each other; it arises from the outer under half of the collar-bone, from the outer margin of the acromial process, and the whole under edge of the spine of the blade-bone, tendinous and fleshy; it forms a thick and bulky Muscle, of which the anterior and posterior fibres pass downwards and outwards, and the middle, or those from the acromion, directly downwards, in numerous thick bundles, which diminish in extent but increase in thickness till inserted into the rough surface or deltoid process of the upper arm-bone. *Use.*—This muscle performs various and very opposite motions, and its whole mass never acts simultaneously; its middle fibres, arising from the acromion, raise the arm upon the shoulder-socket, not, however, above the level of the acromion, but this can only be effected by the consent of the clavicular part, and of that portion arising from the scapular spine, both of which, when acting together, strive to pull the arm down to the side; if, however, the middle portion of the Muscle be quiescent, the clavicular part will draw the arm upwards and forwards, whilst that arising from the scapular spine pulls it upwards and backwards

upon the chest. The arm is also rotated upon the glenoid cavity by the alternate action of the fore and hind parts of this Muscle. The elevation of the elbow vertically above the head is a compound motion, in which the Deltoid Muscle, and indeed only its clavicular portion, bears a part.

Attached to the back and edges of the blade-bone there are three Muscles, which connect it with the great tubercle of the upper arm-bone.

M. Supra Spinatus (Pl. IX., fig. I. d.) is covered by the scapular insertion of the *M. Trapezius;* it fills up the whole of the supra-spinate pit, from whence it arises fleshy, as well also as from the inside of a tendinous expansion, which, running from the spine to the upper edge of the bone, prevents the starting of the Muscle; its fibres collect into a broad flat tendon, which runs over the top of the capsular ligament of the shoulder-joint, with which it is closely connected, and it is inserted into the fore and upper part of the great tubercle. *Use.*—It assists the middle of the Deltoid in raising the arm from the side, and slightly outwards.

M. Infra Spinatus (e.) is partially covered by the scapular origin of the *M. Deltoides*, it fills up the whole of the infra-spinate pit, originating by numerous little bundles of muscular fibres, which, as they ascend up to the shoulder-joint, ultimately collect into a tendon, which spreads over the capsule, becomes confounded with it, and is inserted into the middle of the great tubercle. *Use.*—It rotates the arm outwards when hanging against the side, but also assists in elevating it vertically above the shoulder.

M. Teres Minor (Fig. II. h.) arises tendinous and fleshy from the middle two-thirds of the lower edge of the blade-bone, between the origin of the long head of the *M. Triceps Extensor*, and that of the *M. Teres Major:* it forms a flat belly, which ascends and terminates in a short stout tendon inserted into the under part of the great tubercle. *Use.*—It rotates the arm outwards; if the Arm be not elevated above the horizontal posture, it antagonizes the middle of the *M. Deltoides* and the *M. Supra-* and *Infra-Spinatus;* but if the arm be raised above that posture, it also helps to elevate it vertically.

The antagonists of these three Muscles, in reference to rotation, are the *M. Pectoralis Major*, *Latissimus Dorsi*, and the clavicular origin of the *M. Deltoides*, already described, together with the two following, viz.:—

M. Subscapularis (g.), a very large mass of interweaving muscular fibres which fill up the whole of the subscapular part, and originate from its surface; they collect as they ascend, and are connected to a large broad tendon, which expands over the front of the capsular ligament of the shoulder-joint, and is inserted into the little tubercle of the upper arm-bone. *Use.*—It rotates the arm inwards, and when raised up the horizontal posture assists in elevating it vertically.

M. Teres Major (Fig. I. f.) assists the *M. Latissimus Dorsi* in forming the posterior margin of the arm-pit; it arises from the triangular space at the back of the lower angle of the blade-bone, and from the lower part of its inferior margin it forms a straight flat Muscle which passes upwards and outwards, and as it approaches the arm sends out a wide flat tendon which is inserted into the inner or hind edge of the bicipital groove with the tendon of the *M. Latissimus Dorsi*, but anterior to it, and continuing its insertion below it. *Use.*—It approaches the arm to the side, rotates it inwards, and in whatever state of elevation the arm may be, depresses or brings it again to the side.

Of the remaining three Muscles which connect the blade-bone and arm, one only is inserted into the upper and the other two into the fore arm.

M. Coraco-brachialis (Fig. II. i., fig. IV. i.) arises tendinous and fleshy from the fore part of the coracoid process; it passes down along the inner part of the upper arm, and is inserted rather above its middle into a ridge, continuing its insertion between the origins of the *M. Brachialis Anticus* before, and of the *Triceps Extensor Cubiti* behind. *Use.*—It brings the arm forwards and upwards upon the chest at the same time, rotating it outwards, and is the Muscle which commences its vertical elevation upon the shoulder-socket; it is, therefore, the antagonist of the *M. Teres Major.*

Upon the back of the arm is a very large Muscle, having three heads or origins, and therefore called

M. Triceps Extensor Cubiti (Figs. III. & IV. j.).—Its *upper* or *long head* commences by a flat tendon from the lower edge of the blade-bone, just beneath the glenoid cavity; it passes between the bellies of the two *M. Teretes*, and soon becomes muscular; its bulk is increased by joining with the *middle head*, which commences at the back of the neck of the upper arm-bone, continues its origin from the back and outer part of the bone; these two are soon joined by a third, the *lower* head, which commences its origin near the insertion of the *M. Teres Major*, and continues to arise from the inner and back part of the bone as low as the pit at the back of the cubital pulley for the olecranon. About the middle of the arm the surface of the Muscle begins to be tendinous; the quantity of tendon increases as it descends, and a little above the elbow forms a broad strong expansion, which is inserted into the upper and outer part of the olecranon. *Use.*—By its scapular head this Muscle draws the whole arm back upon the blade-bone, and it also assists the other two heads in extending the fore upon the upper arm, which is the only office they perform. When the arm has been elevated it assists in depressing it.

M. Biceps Flexor Cubiti (Fig. II., IV., & V. k. k.) is situated upon the front of the upper arm, and in moderately muscular persons its form and course are distinctly seen; it arises by two heads; the *long head* commences by a slender tendon from the upper edge of the glenoid cavity of the blade-bone, within the ligamentous capsule of the shoulder, but excluded from the joint itself by the reflexion of the synovial capsule; it runs over the top of the upper arm-bone, and emerging from the capsule between the two tubercles, descends along the upper arm in its own peculiar groove, the synovial membrane enveloping it for some distance; soon after its escape from the arm-pit, through which it passes, it forms a large rounded belly, which again becomes tendinous just above the elbow-joint, where it receives the tendon of the *short head*, which has arisen tendinous and fleshy from the coracoid process, in common with the *M. Coraco-Brachialis*, has descended for about a third of its length connected with that Muscle, and then formed its own distinct belly, which lies on the inside of that of the long head, from the lower end of which its tendon is given out. Opposite the bend of the elbow a tendinous expansion is given off, which, spreading over the whole fore arm, descends to the wrist and is lost upon the hand. The

tendon itself dips down between the flexors of the hand and fingers and the supinators of the fore arm, and is inserted at the inner and back part of the tubercle of the spoke-bone. *Use.*—This Muscle, acting upon the whole arm by its long head, is a principal agent in raising it upright above the shoulder, and by the short head the limb is brought upwards and forwards. It bends the fore upon the upper arm, thereby antagonizing the *M. Triceps Extensor;* and it renders the fore arm and hand supine, which motion may be performed by it when the fore arm is extended, or when it is in any degree bent, or being bent upon the upper arm. When it acts it also tightens the tendinous sheath of the fore arm in the same manner as the *M. Tensor Vaginæ Femoris* acts on the sheath of the thigh.

M. Brachialis Anticus (figs. IV. & V. l.).—This large mass of Muscle commences its origin on each side of the insertion of the *M. Deltoides;* it continues arising from the front of the upper arm as low as the pit for the cubital coronoid process; the front of the Muscle below becomes tendinous, more tendon is produced as it expands over the front of the elbow-joint, and it is inserted into the coronoid process of the cubit. *Use.*—It bends the fore upon the upper arm, and has no other action.

Antagonizing the last Muscle is the

M. Anconeus (fig. VI. m.), which, originating from the back of the outer condyle of the upper arm, passes inwards and downwards, and is inserted into the outer upper fourth of the cubit. *Use.*—It extends the fore upon the upper arm, but performs no other office.

The Muscles upon the fore arm arise partly from the upper and partly from the fore arm itself; for the most part their muscular bellies do not descend below the middle of the arm, and hence, from the less space occupied by their tendons, the lower is much more slender than the upper part of the fore arm. They are divided into sets, viz., flexors and extensors of the hand, pronators and supinators of the spoke-bone, consequently also of the hand, and long flexors and extensors of the fingers. Of these the flexors and one of the pronators partially arise from the inner condyle of the upper arm-bone; and the greater number of the extensors, and both the supinators, from the outer condyle.

The Flexing Muscles of the Hand are three.

M. Palmaris Longus, sometimes wanting, is situated the most superficially, arises tendinous from the front of the inner condyle, has a small fleshy belly which speedily sends out a long tendon; this descends in the front of the fore arm, and is inserted into the palmar sheath, which consists of longitudinal and transverse tendinous fibres, thickest in the upper and middle part of the palm, and attached to the digital sheaths of all the fingers; it is thinner upon the short Muscles forming the ball of the little finger, and thinnest upon the ball of the thumb. *Use.*—It bends the hand upon the fore arm, and assists in pronation.

M. Flexor Carpi Radialis (fig. V. n.) arises tendinous from the front of the inner condyle of the upper arm-bone, and also from the fore and upper part of the cubit; about a third of the fore arm downwards it becomes tendinous, and, inclining outwards as it descends, passes behind the annular ligament, is continued through the groove in front of the trapezial bone, and is inserted into the front of the base of the metacarpal bone of the fore finger. *Use.*—It bends the hand forwards and inwards upon the fore arm, and assists in performing pronation.

M. Flexor Carpi Ulnaris (fig. V. o.) is situated on the inside of the fore arm, arises tendinous from the inner condyle of the upper arm-bone, and fleshy from the outside of the olecranon; it becomes tendinous on the middle of the fore arm, runs down along the inner and fore part of the cubit, and is inserted into the pisiform bone. *Use.*—It bends the hand upon the fore arm.

The extending Muscles of the Hand are also three.

M. Extensor Carpi Radialis Longior (fig. VI. p.) is situated on the outer and back part of the fore arm, covered partially at its origin by the *M. Supinator Longus* (a.), to be hereafter described; it arises by a broad fleshy origin from the ridge above the outer condyle of the upper arm, is fleshy for some distance, then sends out a strong flat tendon, which, passing close to the spoke-bone, is continued through the groove at its base, and is inserted into the back of the base of the metacarpal bone of the fore finger.

M. Extensor Carpi Radialis Brevior (fig. VI. q.) has its muscular part covered by the last Muscle, arises fleshy from the outer condyle of the upper arm-bone, and from the brachio-radial ligament; about the middle of the fore arm sends off its tendon, which, passing to the inner side of the preceding, is inserted into the back of the base of the middle metacarpal bone. *Use.*—The two last described Muscles extend the hand upon the fore arm.

M. Extensor Carpi Ulnaris (fig. VI. r.) arises tendinous from the back of the outer condyle of the upper arm-bone, immediately external to the *M. Anconeus*, becomes fleshy, and having reached the lowest insertion of that Muscle obtains some fleshy fibres from the outer and back part of the cubit; near the lower part of which it gives off its strong tendon, which is continued in the pit on the outside of the cubital styloid process, and is inserted into the upper and back part of the base of the innermost metacarpal bone. *Use.*—It extends the hand upon the fore arm.

The proper Pronator Muscles of the Hand, operating on it through the medium of the spoke-bone, are two:

M. Pronator Radii Teres (fig. VII. a.) arises from the inner condyle, the outermost of all those which arise from it; it also originates from the coronoid process of the cubit: its fibres pass downwards and outwards, become tendinous, and the tendon is inserted into the outer and back part of the middle of the spoke-bone. *Use.*—Besides its proper action, it also flexes the fore upon the upper arm.

M. Pronator Radii Quadratus (fig. VII. b.), at the lower and fore part of the fore arm, and covered by all the tendons of the Flexor Muscles of the fingers; it arises tendinous and fleshy from the inner and fore part of the cubit; is a square Muscle, as its name implies; its fibres pass outwards, and it is inserted into the outer edge of the spoke bone. *Use.*—It only renders the hand prone.

Besides these two, all the Muscles originating from the inner condyle, except the *M. Flexor Carpi Ulnaris*, indirectly tend to render the hand prone.

Their direct Antagonists are also two:

M. Supinator Radii Longus (fig. VI. a.): this covers all the Muscles arising from the outer condyle of the upper arm-bone and the ridge above it; its origin is fleshy and broad from the commencement of the outer

condylar ridge as high as the middle of the bone; its fleshy belly assists in making up the fullness on the outside and immediately below the outside of the elbow-joint; about the middle of the fore arm it sends out a flat tendon, which running close to the outside of the Spoke-bone is inserted into the outside of its base. *Use.*—Besides its proper use, when the hand is prone it assists in extending the fore upon the upper arm.

M. Supinator Radii Brevis (fig. VI. b.): this Muscle is deeply situated, and covered by the three Muscles at the outside of the elbow, viz., the last mentioned, and the two radial extensors; it arises from the outer condyle itself, and from the brachio-radial ligament; it passes downwards and inwards, and becoming tendinous and fleshy is inserted into the fore and inner part of the spoke-bone from its neck down to the insertion of *M. Pronator Radii Teres*. *Use.*—Similar to the last.

Besides these, the extensors of the fingers and thumb, especially those of the latter, assist in performing supination.

The Long Flexors of the Fingers consist of two to the Fingers and one to the Thumb.

M. Flexor Digitorum Sublimis Perforatus (fig. V. a.) arises from the inner condyle of the upper arm, between the Radial and Ulnar Flexors; also from the coronoid process of the cubit, and from the spoke-bone, just by the insertion of the *M. Supinator Radii Brevis;* about the middle of the fore arm it exhibits four muscular bellies, not of large size however, and these send out as many tendons, which descending behind the transverse ligament of the wrist pass through the hand on the first row of the digital pieces, are perforated by the following Muscle, and are inserted by two slips each into the second row of digital pieces. *Use.*—Primarily, they bend the second joints of the fingers into the hand; and, secondarily, the hand upon the wrist.

M. Flexor Digitorum Profundus Perforans (fig. VIII. b.) is situated close to the cubit and inter-osseous ligament, and more especially covered by the last Muscle; it arises from the cubit, between its coronoid process and the origin of the *M. Pronator Radii Quadratus*, and also from the front of the ligament, fleshy; it forms four strong tendons, which pass behind and rather to the inner side of the last, and descending behind the transverse ligament of the wrist enter the hand, continue through the palm, pass into the digital sheaths, by which they, as well as those of the last Muscle, are prevented from starting, and perforating their tendons are inserted into the fronts of all the third row of digital pieces. *Use.*—This Muscle bends the third joints of the fingers upon the others, and the whole of the fingers into the hand; it also bends the hands upon the fore arm.

In the palm of the hand, and from the outer side of each of these tendons, originate the

M. Lumbricales (fig. IX. c. c. c.), four in number, like as many earth-worms, which, passing onwards, are inserted by their tendons into the outer side of the first row of digital pieces. *Use.*—They bend the first joints and incline them outwards.

M. Flexor Longus Pollicis (fig. VIII. d.), which arises by a fleshy origin from the front of the spoke-bone, between its tubercle and the insertion of the *M. Pronator Quadratus;* it has also commonly a very small slip or little belly derived from the inner condyle of the upper arm-bone; at the termination of its origin it gives off a tendon, which passes behind the transverse ligament into the hand, and running along the inside of the metacarpal bone of the thumb and its two digital pieces is inserted into the extreme one. *Use.*—It bends the thumb into the palm, and assists in bending the hand upon the fore arm.

On each side of the tendon of the last Muscle, as it runs along the metacarpal bone, is situated the

M. Flexor Brevis Pollicis (fig. V. e.), consisting of two bellies, the outer one arising from the front of the trapezoid, and the inner from the great and unciform bone; and each of these is inserted either in the sesamoid bones, usually existing at the first joint, or into the edges of the base of the first digital piece. *Use.*—It bends the first joint on the metacarpal bone, and that bone upon the trapezial bone.

The Extensors of the Fingers are also five, three of which belong to the Thumb.

M. Extensor Digitorum Communis (fig. VI. f.) arises from the back and outer part of the outer condyle of the upper arm-bone to the outside of the origin of the *M. Extensor Ulnaris*, and is connected with that of the *M. Supinator Brevis;* it is not a very powerful Muscle, but about the middle of the arm sends out four tendons, which pass over the back of the wrist and hand, on the latter of which they are usually connected by oblique tendinous slips, are then continued to the backs of the fingers, upon the whole of which they spread, and are inserted into the last digital pieces. Sometimes a fifth belly, then called *M. Extensor Proprius Minimi Digiti*, springs from the cubit alone, and is inserted into the little finger. *Use.*—To extend all the fingers.

M. Extensor Ossis Metacarpi Pollicis (fig. VI. g.) arises from the outer and back part of the cubit, from the inter-osseous ligament, and from the inner and back part of the spoke-bone; as it descends it is crossed by the Radial Extensors; its tendon runs along the outside of the base of the latter bone through its outermost groove, and is inserted into the back of the trapezial and of the base of the metacarpal bone of the thumb.

M. Primi Internodii Pollicis (fig. VI. h.) originates below the preceding from the cubit and the inter-osseous ligament; its tendon accompanies the last, runs along the outside of the metacarpal bone, and is inserted into the outside of the first digital piece.

M. Secundi Internodii Pollicis (fig. VI. i.) arises from the same parts as the last Muscle, but below them; its tendon is crossed by the Short Radial Extensor; it runs through the little deep groove at the back of the base of the spoke-bone, and it is inserted into the outside of the base of the second digital piece of the thumb. *Use.*—All these three Muscles extend those parts of the thumb to which they are attached; the first of them, however, only the metacarpal bone, but the last the whole thumb. They also bring the thumb back towards the back of the hand when it has been brought forward by the *M. Flexor Ossis Metacarpi;* and all assist in supination of the hand.

Three other Muscles of the Thumb, also short ones, remain to be described.

M. Abductor Pollicis (fig. VIII. j.), situated on the outside of the ball of the thumb, arises tendinous from the transverse ligament, and from the trapezial bone; it is inserted into the front of the root of the first digital piece of the thumb.

M. Flexor Ossis Metacarpi Pollicis (fig. IX. k.*), beneath the former, has also the same origin: it is inserted into the fore and under part of the metacarpal bone of the thumb.

M. Adductor Pollicis (figs. V. & IX. k.) is a broad triangular Muscle originating from the whole length of the front of the middle metacarpal bone; it collects together as it passes downwards and outwards to be inserted tendinous into the back of the base of the first digital piece of the thumb. *Use.*—The former of these Muscles carries the thumb outwards and forwards from the palm; the second bends the metacarpal bone towards the wrist; and the third draws it inwards and backwards into the palm.

The Little Finger has also three Muscles; by one of which it is bent into the palm, by the second drawn inwards from the other fingers, and by the third outwards towards them.

M. Abductor Minimi Digiti (fig. IX. l.) arises tendinous from the pisiform bone and transverse ligament; it forms a fleshy belly on the inside of the palm, and is inserted into the inside of the base of the first digital piece.

M. Flexor Proprius Minimi Digiti arises from the transverse ligament and from the hook of the unciform bone; it is inserted into the root of the first phalanx of the little finger.

M. Adductor Minimi Digiti (fig. IX. m.) is covered by the last Muscle, and has the same origin; it is inserted into the whole length of the inner and fore part of the metacarpal bone of the little finger.

Between the metacarpal, as between the metatarsal bones, there are also short Muscles called

M. Interossei, seven in all; of these the four *anterior* or palmar ones are single-headed, and the three *posterior* are double-headed; their thin tendons are inserted on the sides of the first row of digital pieces. *Use.*—To bring each finger inwards or outwards towards that side on which they are inserted.

Anatomy.

ANATOMY.

SECTION III.

OF THE SENSES.

The *general* properties and functions of the Brain and Nerves having been already considered,* the Anatomy and appropriate or *specific* Physiology of the Organs of Sense remain to be treated of under the present head. The senses may be defined as those organs by which external impressions are received and conducted to the Sensorium; each sense, therefore, consists of a recipient surface and propagating medium. To the constitution of a perfect organ the following essentials must be present:—1. A special nerve; 2. An appropriate stimulus from without; 3. A capacity on the part of the former (the nerve) to appreciate the specific influence of the latter (the stimulus). Thus it will be perceived that the *Nerve* is the fundamental part of the sense, whilst the so-called *organ* merely presents a surface for the extension of the nervous matter, and a mechanism more or less complex for the modification of external impressions. It is not difficult to trace the operation of appropriate impressions on the various Organs of Sense, but it is quite beyond the limit of our present knowledge to follow them further; and all the theories which have been broached to throw light on this subject amount to little else than idle speculation. Observation and experiment have enabled the physiologist to isolate (or nearly so) those parts of the brain which are associated with the external senses (see ANATOMY OF THE BRAIN); but this knowledge affords him no clue to the intricate problem above alluded to. Before concluding these introductory observations, the reader should be reminded that what we denominate "Sound" and "Light," "Odours" and "Tastes," have no abstract existence: the conditions necessary for the production of these effects may exist, but the effects themselves are recognized only in connexion with appropriate organs to receive and communicate the impressions: thus, no words can convey the idea of what light is to the blind; nor can the deaf man form an adequate notion of what is meant by sound. Lastly, it may be remarked that all impressions made on the Senses are more or less transient in themselves, *i. e.*, the *material* effect does not long survive the cause. It is only when the mysterious boundary is passed, and impressions become acknowledged and associated by the *immaterial* part of our nature, that they assume a permanency which converts them into materials that constitute the fabric of all our knowledge.

The Senses are five in number: they will be described in the order of enumeration;—Smell, Taste, Touch, Hearing, and Sight. In each instance the description of the mechanism of the organ will be succeeded by that of its nervous and vascular organization, and its physiology.

* 'Nervous System,—Structure and Physiology,' p. 151.

ORGAN OF SMELL.—The Nose, properly so called, constitutes but a small portion of the organ by which odours are perceived. It is more or less prominent and pyramidal in form, projecting from the face between and below the eyes and above the mouth. It is composed of bones, cartilage, mucous membrane, and common integument. The external aperture is divided, not always symmetrically, by a central cartilaginous septum. The *back* of the nose is formed by the junction of the nasal bones above, and of the lateral cartilages below: it is upon the development of these bones that the form of the organ is chiefly dependent.* The *Alæ* or *wings* constitute the lateral boundaries of the nostrils, and are prolonged into the *lobe* or extremity of the nose. These alar cartilages are two in number on each side, the superior being triangular and flattened, the inferior curved and convex externally. The *Septum* of the nose is formed by a fifth cartilage, which is triangular and flat, and continuous with the bony plate which divides the nostrils behind. It meets the alar cartilages below in the lobe, and is here covered by a thick fold of the common integument called the *Columna*, which connects the tip of the nose to the upper lip. The lobe and columna are moulded on a separate pair of cartilages.

The *Nostrils* are a pair, oval in form, and bounded by the septum and columna internally, and by the alar cartilages externally. Their inner surface is furnished with strong hairs, which are of use to arrest the introduction of extraneous bodies during the act of inspiration. The *Nasal Cavity* presents an extended surface covered throughout by mucous membrane, and is in communication with several *Sinuses* which are likewise invested by productions of the same continuous membrane. The bones which constitute the nasal cavity are fourteen in number, of which four are single bones and five are pairs. A central partition divides this cavity into two portions: this septum is vertical and continuous with the anterior cartilaginous septum of the nostrils already alluded to. It consists of the vomer, joining before with the nasal plate of the ethmoid bone, below with the palate and superior maxillary bones, and above with the sphenoid. The lateral boundaries consist of the superior maxillary, palate, sphenoid, ethmoid, turbinated, and lachrymal bones; the roof being formed by the frontal, ethmoid, and sphenoid bones, and the floor by the palate and superior maxillary bones. Lastly, the circumference of the common posterior aperture is formed by the sphenoid and palate bones: this outlet communicates, in

* For the description of these and other bones to which it will be necessary to allude, the reader is referred to the 'Osseous System.'

the recent state, with the pharynx. The projection of the convoluted plate of the turbinated and ethmoid bones from the external walls of the nasal cavity, subdivides each lateral half into three compartments or chambers; into the superior of these the posterior ethmoidal and sphenoidal sinuses open. The middle chamber presents the apertures of communication with the frontal anterior ethmoidal and maxillary sinuses; and the inferior receives the nasal duct.*

It has been already remarked that there is a continuous mucous membrane common to the nasal cavity and sinuses; this is denominated the *pituitary* or *Schneiderian* membrane. It is extended over the periosteum of the bony parietes, and covers the nasal surface of the cartilages and septum, being continuous anteriorly with the common integument, and posteriorly with the mucous membrane of the pharynx and larynx. It further sends a production into each sinus, and in the nasal duct becomes identified with the conjunctival membrane of the eye. The pituitary membrane is thicker and more villous in character on the turbinated bones and septum; but in the sinuses it is comparatively pale and thin. Its surface is continually lubricated by *mucus*, which is poured from the orifices of numberless minute follicles, by which means the delicate surface is protected and the function of the organ is rendered more perfect. The *muscles* which move the nose, or its tegumentary covering, are the following:—The *pyramidalis*, which is vertical in its course, and raises the skin covering the nasal bones. The *compressor nasi* covers the ala, and unites with its fellow on the back or bridge of the nose, its use being to compress the corresponding ala. The *levator labii superioris alæque nasi* is partly inserted into the side of the ala cartilage, and thus is enabled to distend or elevate the nostril. The corresponding *Depressor* is its antagonist.† *Arteries.*—The principal internal artery of the nasal cavity is the spheno-palatine branch of the internal maxillary. This enters by the foramen of that name, and immediately divides into branches which ramify beneath the mucous membrane upon the septum and turbinated bones, also sending twigs to the ethmoidal cells and antrum. The superior palatine artery also sends a small branch through the anterior palatine foramen to the nasal fossa, and the antrum is likewise supplied from the upper alveolar artery. The posterior ethmoidal branch of the ophthalmic sends some twigs down through the cribriform plate of the ethmoid bone to the pituitary membrane, and the internal carotid itself supplies the sphenoidal sinus. The facial supra and infra-orbital branches supply the cutaneous surface of the nose. The *Veins* pursue nearly the same course as the arteries; one of them sometimes communicates directly with the anterior extremity of the longitudinal sinus of the skull. *Nerves.*—The nasal cavity is supplied by nerves of specific and common sensibility: the former are the olfactory, the latter are derived from the fifth pair. The olfactory nerves (a pair) divide on either side of the crest of the ethmoid bone into numerous branches, and assuming a firm consistence descend through the foramina in its cribriform plate. They carry with them investing sheaths of dura mater, and are distributed *externally* on the turbinated bones, and *internally* on the septum nasi, ramifying between the periosteum and pituitary membrane, in the latter of which they terminate. The sensitive nerve of the nose is the nasal branch of the ophthalmic division of the fifth pair. After traversing the orbit, this nerve enters the skull by the anterior of the internal orbitar foramina, and almost immediately descends through the cribriform plate of the ethmoid bone into the nasal fossa. It is distributed to the lining membrane and skin of the nostril, and to the mucous membrane of the nasal chambers. In addition to the foregoing, the nose receives filaments from the spheno-palatine ganglion of the sympathetic system. One of these is derived from the palatine nerve, and passes through a foramen in the nasal plate of the palate-bone, to terminate in the mucous membrane between the turbinated bones. Several smaller filaments pass from the above ganglion through the spheno-palatine foramen, and are distributed in common with the last.

Physiology.—From what has been said respecting the nervous organization of the sense of smell, it will be perceived that this organ is endowed with a specific sensibility by which various odours are distinguished; and with common sensibility, by which the intrusion of foreign particles during respiration is arrested. There appears little reason to doubt that all the sources of stimulus are material, whether in a solid, fluid, or gaseous form. Thus, both the nerves of common and specific sensibility may be simultaneously excited by fine powders, conveyed by the atmosphere to the sensitive surface. It appears essential, however, that whatever may be the stimulus, it should be ultimately dissolved or suspended in the mucus, which thus becomes its real menstruum when applied to the sentient extremities of the nerves. Thus the morbid condition in this secretion in catarrh impairs, or totally suspends for a time, the specific function of the organ. Scents are naturally conveyed to the organ of smell at each inspiration, and thus we are in part made aware of the presence of matter which may be noxious to the lungs. By voluntary inspiratory efforts, a current of air is thrown at pleasure upon the mucous surface, by which means an odour is rendered more or less intense; thus animals, in following their prey, "snuff" the air on the ground, the act consisting of short and frequently repeated inspirations. Although this sense is infinitely more acute, under certain circumstances, in animals than in man, it is probably much more limited in its range. The specific stimulus varies according to the habits and wants of animals, whereas in man the extension and uniformity of its sphere renders the sense of smell a source of enjoyment, as well as of usefulness; for we cannot reasonably doubt that the sweet scents, which are so abundantly diffused throughout the vegetable kingdom, are unappreciated by animals, as they possess no attraction save where they act as a guide in the selection of food. An illustration of this point is found in the fact that odours affect different individuals in various ways, some regarding as agreeable what others are disgusted with; and again, certain scents, particularly of flowers, are not perceptible to some persons, but are overpowering to others. This sense is occasionally impaired, or totally lost for a time (sometimes permanently), after severe concussion or other affections of the brain.

ORGAN OF TASTE.—The *Tongue*, which is the seat of

* As it seems doubtful whether these sinuses are in any way subservient to the sense of smell (at any rate in man), no further notice will be here taken of them.

† For further particulars, see 'Muscular System,' pp. 410-11.

Anatomy. this sense, is a highly endowed muscular organ, consisting of two lateral portions, which are symmetrical. Its form is triangular, being broad at its base, where it is connected posteriorly by a continuous mucous membrane to the palate and epiglottis, and inferiorly by several pairs of muscles to the os hyoides and lower jaw. Its anterior extremity is pointed and free. The body of the tongue presents a superior surface, which is slightly rounded and marked by a central longitudinal groove when in a state of rest: it may be rendered concave or convex. The under surface is convex, and attached by a central fold of mucous membrane (*frænum linguæ*) to the neighbouring parietes of the mouth. The margins are rounded, and connected at their posterior extremities by the anterior pillars of the fauces to the arch of the palate. The mass of the tongue is made up of the *muscles* which move it. They consist of the following pairs:—The Stylo-glossus, which draws the tongue backwards and to one side; the Hyo-glossus, which depresses the side of the tongue, and thus renders its back convex; the Genio-hyo-glossus, the extent and position of which render it the most important agent in the motions of the tongue. Its mesial insertion enables it to render this organ concave; its posterior fibres draw the base of the tongue forwards, and thus thrust the point from the mouth, whilst its anterior retract the apex, and cause it to point downwards. The lingualis consists of a longitudinal fasciculus of fibres, which traverse the tongue external to the last described, from its apex to its base: they shorten the organ and retract its tip. Several other muscles connected with the os hyoides and lower jaw act indirectly on the tongue. It should be remarked, that an unusual quantity of fatty matter is found intimately mixed with the muscular structure of this organ.* The *Mucous membrane* of the tongue is continuous with that of the mouth generally. It is not characterized by any peculiarity on the under surface of the organ, but on the upper surface it is rendered uneven by the prominence of papillæ and the large mucous follicles, which are distributed unequally over it. These papillæ are divided into lenticular, fungiform, and conical, names derived from their varied form. The first are large follicles with open mouths, arranged in two rows, which are separated anteriorly, and converge to an angle posteriorly, where the largest and deepest (*foramen cœcum*) is seen. The fungiform and conical papillæ are distributed severally over the edges and dorsal surface of the tongue, presenting the appearances which their names denote.

The *Arteries* of the tongue are the lingual branches of the external Carotid; they arise nearly opposite the corner of the Os hyoides, and take a tortuous course forwards, upwards, and inwards towards the base of the tongue, and then insinuating themselves between the hyo and genio-hyo-glossi muscles of either side, they run forwards towards the tip, where they terminate; they distribute branches in their course, which are severally named, according to their destination, dorsal, sublingual, and ranine. The *Veins* accompany the arteries. The *Nerves* of the tongue are three pairs: the lingual branch of the fifth, the glosso-pharyngeal of the eighth, and the hypo-glossal or lingual motor. After separating from the dental nerve, the lingual branch of the fifth is found lying between the internal lateral ligament of the lower jaw and the internal pterygoid muscle; thence it passes between the upper margin of the sub-maxillary gland and mucous membrane of the mouth, and here joins the Whartonian duct, which it accompanies between the mylo-hyoid and hyo-glossus muscles; it lastly crosses above the sub-lingual gland, to divide into its terminating filaments on the outer surface of the genio-hyo-glossus muscle. After giving off branches, which are distributed to the various textures along which it passes, viz., the muscles, glands, and mucous membrane of the mouth, gums, and pharynx, it communicates freely with the lingual motor nerve, and its ultimate filaments are distributed to the mucous membrane of the whole upper surface of the tongue as far as its tip. The Glosso-pharyngeal nerve escapes from the skull by the posterior lacerated foramen, and almost immediately crossing from the anterior to the inner side of the internal Jugular vein, it proceeds in company with the Stylo-pharyngeus muscle, between the external and internal Carotid arteries, to the base of the tongue; here it terminates, by distributing its filaments to the mucous membrane in this region, and to that of the epiglottis, tonsils, and upper part of the pharynx. Lastly, the ninth or lingual motor nerve leaves the skull by the anterior condyloid foramen, and taking a course downwards and forwards it hooks round the occipital artery and passes external to the par vagum, superior cervical ganglion, and both external and internal carotid arteries. It next appears from under cover of the digastric muscle, and forms a loop with its convexity downwards, prior to its disappearance between the mylo-hyoid and hyo-glossus muscles. After giving off its long descending branch, which is distributed to the muscles which depress the larynx, it gives off filaments to the following muscles: the mylo-hyoid, genio-hyoid, thyro-hyoid, stylo-pharyngeus, constrictor pharyngis superior, and those already enumerated as specially acting on the tongue. After quitting the hyo-glossus (which muscle is interposed between the corresponding artery and nerve), it runs forwards in company with the lingual vessels between the genio-hyo-glossus and lingualis muscles to the tip of the tongue, where its ultimate filaments terminate by being exclusively distributed to muscles. It communicates freely with the lingual branch of the fifth. Anatomy.

Physiology.—The senses of smell and taste are closely allied, the impression being direct in either instance. It would appear that the sense of taste does not reside wholly and exclusively in the tongue; the fauces partake of the endowment. The stimulus may be presented, as in the sense of smell, in a solid, fluid, or gaseous form; and the conditions of the organ for specific perception are likewise similar, viz., a moistened surface, and solution or suspension of the excitant, if a solid. The true nervous seat of taste has been a subject of dispute amongst physiologists, and the recounted experiments are very contradictory. No doubt, however, exists that the hypo-glossal is the motor nerve of the tongue, though it does not appear to be totally devoid of sensibility, which is probably attributable to the interchange of fibrils between it and the fifth. The weight of evidence is in favour of this latter being the gustatory nerve, though we have certain evidence that it also presides over common sensibility. The most probable function of the Glosso-pharyngeal nerve

* For further particulars, see 'Muscular System,' p. 413.

Anatomy. is to combine the actions of the tongue and pharynx in deglutition. The senses of taste and smell often co-operate for the production of a more perfect result; thus, wines cannot be so accurately appreciated, nor indeed any delicate flavour, when the nostrils are closed. Taste also is affected, as smell, in catarrh, probably rather from the cause above alluded to than from direct local affection. We know nothing respecting the mode by which we are enabled to distinguish between different tastes and scents. The tip of the tongue is highly endowed as an organ of common sensation, which property it derives from the lingual branch of the fifth nerve. In addition to the above functions, the tongue is a most important agent in the acts of mastication, deglutition, and articulation.

Sense of Touch.—The organ of this sense is not limited to any particular locality, though the intensity of the sense itself varies much in different parts. The nervous filaments of common sensation may be traced back to the posterior roots of the spinal nerves, which have their origin in the brain—a fact demonstrated by the loss of sensation when the communication with this nervous centre is cut off. By far the largest proportion of these filaments terminate in the true skin, which is protected by an unorganized covering, the cuticle.* The generally diffused sense is usually termed "common sensation;" whilst the more highly endowed parts, as the fingers and tongue, constitute the "appropriate sense." by which greater nicety of distinction is possessed. Pleasure, pain, heat, cold, &c., are modifications in excess, or otherwise, of common sensation. The acuteness of the sense appears to depend on the proportion of nervous matter distributed to a given space. It seems probable that some individuals possess more acute sensibility than others; and it is to be hoped that most animals are less gifted in this respect than man. The sexual pleasure appears to be a refinement of the form of common sensation above alluded to, rather than an appropriate sensibility *sui generis*, its peculiarity consisting in the crisis of the orgasm producing the excited effect of seminal emission. But this is only the result of an adaptation of appropriate structures and functions to each other for the attainment of a desired end; for the peculiar property of the pudic nerve soon ceases when the chain is broken by the removal of an essential link, such as the secreting organs of the generating fluid. The endowed structure in the production of the act of generation is that part in which the ultimate filaments of the pudic nerve are distributed, whether that structure be perfect or mutilated; and thus in this instance, as in the *Senses*, it is the peripheral extremities of the nerve, and not the *organ*, which are the real seat of the emotion.

The *causes* of sensation are various, viz., mechanical, chemical, electrical, &c.; the first mentioned are by far the most frequent. The fingers and tongue are the parts most highly endowed in man; whereas the lips are specially the seat of the sense in some animals, as the horse; the extremity of the proboscis in the elephant, &c. Many parts not naturally sensible become so under inflammation, as tendon, cartilage, and probably horn and teeth. The great centre of all sensation, the Brain, is insensible. How sensation is conveyed to the sensorium we know not; it may be by pulses or undulations, of which the nerves are the conductors. Pain may result from violence, the effect being purely mechanical; but where heat or external cold are the causes, it is probable that there is a chemical change in the organized tissue. The amount of sensation in these cases bears a direct proportion to the conducting power of the body touched. Habit improves and perfects our appreciation of the form, surface, &c., of objects in the same way as the eye requires experience to calculate distance. The greatest perfection of the organ of touch is exemplified in the congenitally blind, who employ the sense vicariously. Such individuals are taught to read by raised letters, and instances have been authenticated where various colours have been distinguished; but this may be accounted for by some appreciable difference produced in the texture of the cloth by the dye employed to colour it, and has nothing in common with the marvellous tales of the Mesmerists. The hand is highly endowed in man, and peculiarly fitted for the office of an organ of touch by its form and mobility. It is by the adaptation of the thumb and fingers that we are enabled to appreciate dimensions; and by the pronation and supination of the fore arm we judge of form and surface. Lastly, it may be noticed that some sensations have their origin in internal or central causes.

Organ of Hearing.—The mechanism of the internal Ear, which constitutes the modifying apparatus of this organ, is very complex. The *Labyrinth* is the part endowed with the sense of hearing; *i. e.*, it presents a surface on which the ultimate filaments of the auditory nerve are distributed. It is partly osseous, and in part membranous, and is divided into three compartments; 1. Vestibule; 2. Semicircular canals; 3. Cochlea. The *Vestibule* is placed to the inner side of the tympanum, having the cochlea anterior and inferior to it, and the semicircular canals above and behind it. Its diameter is one-fifth of an inch by one-tenth laterally, and it presents the following openings; foramen ovale, by which it communicates with the tympanum; five orifices of the semicircular canals; cochlear foramen; its own aqueduct, and several minute orifices by which the filaments of the auditory are admitted. The Semicircular canals are three in number, and situated behind the tympanum. Their calibre is about one-twentieth of an inch, and they are somewhat compressed laterally; two are vertical in position, and the inferior of the three is horizontal: of the two vertical the anterior is also superior. The inner extremity of the anterior, and the upper extremity of the posterior, vertical canals unite; hence five instead of six openings into the Vestibule. The *Cochlea* is internal to the Vestibule; it is a coiled tube about an inch and a half long, tapering and forming two and a half curves, the greatest diameter being about one-tenth of an inch at its commencement. This tube is called the *spiral canal*, and its commencement projects towards the tympanum, and forms the *promontory* within that cavity. The *cul-de-sac* at the summit is termed the *cupola;* and the central pillar or *modiolus* is perforated by a middle tube, which presents foramina communicating with either scala for the transmission of nervous filaments. There are two *scalæ* divided by a partition (*lamina spiralis*), which terminates in the *hamulus*, where a communication exists between the two scalæ. The *scala tympani*, which is the lower of

* The reader is referred back to the anatomy of these structures.

the two, communicates with the tympanum by the fenestra rotunda; and the *scala vestibuli* with the vestibule by an oval opening. The aqueduct, which is about a quarter of an inch long, commences at the lower wall of the tympanic scale, and terminates in the jugular pit of the petrous bone. The labyrinthic cavity is lined by a fibro-serous membrane in addition to the proper membrane of the labyrinth. In each compartment of this cavity a fluid is found called the *peri-lymph* or *liquor Cotunnii.* The *membranous labyrinth* is found in the vestibule and semicircular canals only; it floats in the peri-lymph except where connected to the sides of the osseous labyrinth by mucous filaments; the cavity of this membrane contains a limpid secretion, and some particles of calcareous matter. The *accessory* apparatus of the organ of hearing consists of the Auricle, Auditory passage, and Tympanum. The *Tympanum* is interposed between the auditory passage and labyrinth; its greatest diameter is nearly a quarter of an inch. It is lined by mucous membrane, and shut off from the auditory passage by the *Membrana tympani*, which faces backwards, upwards, and outwards, and consists of a double layer of fibrous membrane, lined internally by the membrane of the tympanum, and externally by cuticle. On the inner wall of the tympanum the promontory is seen, above which is the oval or vestibular fenestra, and below it the cochlear or round fenestra. Superior to the former of these is a ridge marking the course of the aqueduct of Fallopius; whilst below and behind it is the pyramid, with an aperture on the summit for the lodgment of the Stapedius muscle, and passage of its tendon. Still further back is the orifice for the entrance of the chorda tympani nerve. In addition to the above openings, there are the following:—On the fore and upper part of the cavity the *Glenoid foramen;* at the lower part the orifice of the *Eustachian canal* and tube for the lodgment of the *tensor tympani* muscle, which two last are separated by a scale of bone; and posteriorly the communications with the mastoid cells. The *osseous* part of the *Auditory passage* is nearly three-quarters of an inch in length, passing from without inwards and forwards, at first being inclined upwards and then downwards; its centre is most contracted. Its outer margin is rough to give attachment to the auricular cartilage; and a groove just within the inner extremity marks the attachment of the membrana tympani. In the fœtus this passage is a mere bony ring, which, attaching itself to the outer wall of the tympanum, subsequently grows into the osseous passage above described. The *Mastoid Cells* are irregular in number and size, and occupy the mastoid portion of the temporal bone; they do not exist in the young. The *Ossicula Auditus* are four in number. The *Malleus* is divided into a rounded head and three processes, of which two are long and the third a mere tubercle; the handle, as the largest process is named, rests on the membrana tympani, and the processus Gracilis projects into the Glasserian fissure. The *Incus* is like a double-fanged tooth, presenting an expanded summit which articulates with the head of the malleus; and two legs, of which the longer is connected through the medium of the *lenticular* bone to the Stapes. The former of these two last named is like a flattened grain of sand; the latter or *Stapes* resembles a stirrup, the base of which is adapted to the vestibular foramen. These bones are contained in the cavity of the tympanum, and stretch from the membrana tympani to the membrane of the vestibular openings. The *Auricle* is placed on the side of the head, and consists of fibro-cartilage invested by common integument. The hollowed portion of the *pinna* is called *concha;* its convex outline is the helix, below which is the *antihelix;* this latter divides above, and the intervening depression is called *fossa navicularis.* Bounding the external meatus anteriorly is the tragus, opposite to which is another elevation called anti-tragus; the most depending part of the auricle is the *lobe.* The external or *cartilaginous auditory passage* joins the osseous canal already described, their joint length somewhat exceeding an inch, and extending from the bottom of the concha to the membrana tympani: this canal is curved, and its concavity faces downwards and forwards; its transverse section presents an ellipse. The skin lining this passage is furnished with fine hairs, and the *ceruminous glands* pour out a bitter secretion from numerous orifices.

The Muscles of the internal ear are two: the the tensor tympani, which lies in a canal above the Eustachian tube, from which, and the adjoining portion of the petrous bone, it arises; on entering the tympanum it bends towards the malleus, into which it is inserted at the junction of the handle and processus gracilis: it makes tense the tympanic membrane. The Stapedius is lodged in the pyramid, from the summit of which it emerges to be inserted into the neck of the stapes: it presses the base of the stapes against the fenestra ovalis, and probably co-operates with the last muscle by drawing the chain of bones inwards. A third muscle is described by some authors, and named laxator tympani, but it appears rather of a ligamentous character. The muscles moving the external ear are the attollens, attrahens, and retrahens aurem, which severally arise in the temporal, zygomatic, and mastoid regions, and act in the directions denoted by their names. Others have been described, which are so rudimentary as to be undeserving of notice.

The *Arteries* which supply the internal ear consist of twigs derived from the internal Carotid and Basilar trunks, and also from those of the dura mater and the posterior aural; the last of which enters by the stylo-mastoid foramen. The external ear is furnished by the continued trunk of the last-named artery, and by twigs from the temporal. The *Veins* correspond to the arteries.

Nerves.—The Auditory nerve enters the internal passage of that name in company with the facial: the former divides at the bottom of this canal into two branches, the anterior or *cochlear*, and the posterior or *vestibular.* The former, flattened, enters by several filaments the apertures of the spiral tract of holes; these pass into the bony spiral lamina, where they spread out in curves: the filaments entering the base of the axis emerge at the summit of the cupola. The vestibular branch presents a gangliform enlargement which divides into three sets of filaments, two for the canals and one for the vestibule. The muscular nerves of the internal ear are derived from the facial and the otic ganglion. It should be observed that the tympanic orifice of the Eustachian tube communicates by an expanded cartilaginous aperture (looking downwards and backwards) with the side of the pharynx, opposite the posterior openings of the nasal cavity.

Physiology.—The organ of Hearing justly occupies an elevated position among the senses; the privation of it can alone convey an adequate notion of its im-

portance, especially where the effect is congenital. Yet is it not only an useful sense; through it some of our tenderest sympathies are awakened, or the depressing effects of the sterner passions assuaged; and thus the adaptation of the organ to the music of nature or art becomes a source of the highest gratification to most persons. *Sound* is any impulse of the air conveyed to our ears, and the body which originates the vibration has been denominated the "Phonic." These airy waves or impulses move like circles produced in water when disturbed by a falling body, and must succeed each other with a rapidity amounting to at least sixteen in the second to produce a continuous sound. The Vestibule is the principal seat of the expansion of the auditory nerve, and communicates, as has been shown, directly with the tympanic chain of bones; it is also that part of the internal ear which is most universally developed, and therefore is probably the most essential part of the labyrinth. The Cochlea is found in more advanced development, and probably receives impressions conveyed through the cranial bones; its peculiar form is a mystery. The semicircular canals have been supposed to subserve the end of detecting the direction of sound: it is certain they present an extended surface for the expansion of the auditory nerve. The External Ear is more developed in many animals than in man: in these instances the size, erect position, and mobility of these organs permit of a more ready detection of the direction of sound. The obliquity of the external auditory passage is a protection against injury to the membrane of the drum and parts within. The tympanum, membrane, and ossicles render the labyrinth independent of atmospheric vicissitudes, and protect it against violence from intensity of atmospheric vibrations. The muscle of the malleus acts directly on the tympanic membrane; that of the stapes mediately on the same part, but more directly on the membrane of the vestibular foramen. The tension of the membrane of the drum renders it more susceptible of vibration, and consequently permits of the appreciation of gentle sounds; but extreme tension prevents the perception of grave tones. The use of the Eustachian tube is to admit air into the tympanum: it may also subserve other purposes, such as the escape of vibrations which might otherwise produce an echo. This last property may likewise be assigned to the mastoid cells, which are doubtless also intended to improve the conducting power of the solid bones.

Organ of Vision.—Under this head will be considered the Orbit, the Globe of the eye, and its appendages. The *Orbits* are conical cavities facing forwards and slightly outwards; their axis is therefore oblique. Each is formed above by the frontal bone; below by the superior maxillary and malar bones; externally by the last named and the sphenoid; internally by the lachrymal, ethmoid, and palate bones: thus, three single bones and four pairs enter into the composition of this cavity. The margin of the orbits is strong and rounded, and well calculated to sustain and ward off external violence. The weakest part of the cavity is its inner wall, and its external is the strongest. The orbitar foramina are,—the optic at the posterior and most contracted part of the cavity; the lacerated external and inferior to the last; the supra-orbitar and frontal in the os frontis; the anterior and posterior ethmoidal between the bone of that name and the frontal: the infra-orbitar canal is also partially open to the orbit, and the spheno-maxillary fissure communicates between this cavity and the spheno-maxillary fossa. The *Globe* of the eye occupies the orbitar cavity, cushioned on a bed of fat, and more or less prominently placed in different individuals and under varying conditions of the frame.* The form of the globe is that of a spheroid, the greatest diameter of which is about an inch, and extending from before backwards. The axis of the two eyes is parallel, and therefore not corresponding to that of the containing cavity. The bulk of the eye consists of the humors, which are more or less supported and surrounded by the membranes.

The *Sclerotic* coat is a fibrous tissue, dense, tough, and white, and investing about four-fifths of the globe. It is thickest where it is perforated for the transit of the optic nerve, and gradually decreases to one-third of its density where it is connected to the cornea; this more attenuated portion is, however, strengthened by the expanded insertions of the muscles which move the globe. Posteriorly this membrane is continuous with the dura mater accompanying the nerve of sight through the optic foramen: its external surface is in part covered by the investing conjunctiva, and internally it is in contact with the choroid membrane. The aperture for the optic nerve is in its posterior aspect, and about one line internal to its centre. The *Cornea* occupies the anterior fifth of the globe, being connected by its margin to the sclerotic. Its transverse rather exceeds its vertical diameter, and it forms the segment of a smaller sphere than the opaque membrane into which it is inserted. The border of the transparent cornea is overlapped, at their junction, by the sclerotic. The texture of the former differs essentially from that of the latter, consisting of laminæ with an interposed transparent fluid. Anteriorly the Cornea is covered by a transparent secreting membrane, and posteriorly by the membrane of the aqueous humor.

The *Choroid* membrane corresponds to the Sclerotic externally, and to the retina within. It is perforated posteriorly by the optic nerve, and anteriorly it is adherent to the Ciliary ligament and processes. This membrane is of a deep brown tint, an appearance which is due to the colouring matter or pigment with which it is stained. It is cellular and highly vascular, its external surface being rough where its connexions with the Sclerotic are broken through, and its internal surface villous where the terminations of the vessels are spread out. The secreting apparatus of the pigment appears to consist of a series of hexagonal plates, with a central nucleus on the inner surface of the choroid. This colouring matter is absent in albinos. The *Ciliary ligament* is an annular band of condensed cellular texture and grey colour, corresponding to the junction of the sclerotic with the cornea, and of the choroid with the iris, and serving as a connecting band between these several tissues. It is perforated by the ciliary vessels and nerves. The *Ciliary processes* are a set of folds continued forwards from the choroid behind the iris. They are highly vascular, and stained with pigment; they are alternately long and short, and about sixty or seventy in number. The hyaloid membrane is marked by their attachment, but their extent is limited anteriorly by the margin of the lens. The *Iris* is a septum placed vertically between the cornea and lens, the convex border of which is attached,

* The sunken eye of the emaciated depends on the absorption of the fatty cushion alluded to.

through the medium of the ciliary ligament, to the choroid membrane; and the concave, or free margin, forms the boundary of the *Pupil*. This aperture is not quite central, but a little inclined to the inner side of the transverse diameter of the eye. It is upon the tint of the iris that the colour of the eye depends. Its posterior surface is stained by pigment, which is more abundant and pervades its structure in dark eyes, but is altogether absent in albinos. The texture seems to be, in part at least, muscular, and to consist of both radiating and circular fibres, of which the former are anterior. It may be remarked that the iris divides the interval between the cornea and lens into two unequal *Chambers*, of which the posterior is much the shallower. The surface of this septum is covered by the membrane of the aqueous humor, and floats in the liquid. During fœtal life a vascular membrane, denominated *Membrana pupillaris*, closes the pupillary aperture; this gradually disappears towards the close of uterine existence. The *Retina* is the expanded termination of the optic nerve, and is, consequently, the true seat of vision. This membrane is interposed between the choroid and the vitreous humor, and extends as far forwards as the posterior margin of the ciliary processes. It is constituted of three layers, the central of which is nervous, the anterior vascular, and the posterior or external serous. These laminæ are connected by vessels and cellular tissue, the nervous expansion thence deriving the support it needs. This membrane, which exhibits an opaque grey appearance on dissection, is perfectly transparent during life. It presents on its inner surface and in its centre, but about two lines external to the optic nerve, a spot where the nervous matter is deficient, and around which the membrane is folded and has a yellow tint; this is denominated the *foramen of Sömmerring*. The central artery of the retina may be seen emerging on its inner surface from the centre of the optic nerve.

The *Vitreous humor* constitutes about three-fourths of the contents of the eye-ball. It is spherical, and presents a depression on its anterior aspect in which the crystalline lens is lodged. The fluid of which its bulk consists is slightly saline, and contained in a cellular membrane called *Hyaloid*, which not only surrounds it exterior, but also forms cells in its interior. The connexions between the hyaloid membrane and choroid folds are very slight; the relation of the retina to the former has been already noticed. At the margin of the lens the hyaloid membrane splits, to invest on both surfaces the crystalline lens. By this arrangement a cellular canal is formed, which surrounds the circumference of the lens, and named after its discoverer, Petit. It should be observed that this canal can only be developed by inflation. The dark markings on the hyaloid membrane, corresponding to the intervals on the plaits of the choroid or ciliary processes, appear themselves to be similarly constituted folds, and are thence named the ciliary body of the vitreous humor. The *Crystalline humor* is a double convex lens, related, as already described, to the membrane of the vitreous humor, and lying behind the iris, where it forms the posterior boundary of the smaller chamber of the eye. Its position corresponds to the axis of the pupil, and its posterior surface is more curved than its anterior. The antero-posterior diameter of the lens is about two lines, which is half of its transverse measurement. The convexity of this body, however, varies at different periods of life, the curves being greater in childhood, when the lens is nearly spherical, and diminishing rapidly after middle age. The crystalline lens is invested by a capsule, which contains a small quantity of transparent fluid called *Liquor Morgagni*, and supposed by some to be a *post-mortem* condition; this capsule is tough and elastic The humor under consideration is far from homogeneous; it consists of radiating fibres, the arrangement of which is very complex, and varies in different classes of animals. Mention has been already made of a large chamber in the eye, situated between the cornea and lens, and divided into two unequal compartments by the floating margin of the iris, which is very nearly in contact with the crystalline humor. This space is occupied by the *Aqueous humor*, a limpid transparent fluid of about five grains' weight. This liquid is supposed to be the product of a membrane which covers the boundaries of the chambers and the surfaces of their floating septum, and thence called aqueous membrane—a fact which has not been anatomically established, although the pathological evidence presented to us would seem to favour the hypothesis.

Under the head of *Appendages*, the following parts will present themselves for examination:—The eye-brows, eye-lids, conjunctiva, and lachrymal apparatus. The *Eye-brows* consist of two arched lines of hairs directed outwards and downwards, and approaching, or even sometimes meeting, in the median line. The integument which supports these strong hairs is thick, and lies over the frontal ridge. The brows are raised by the action of the occipito-frontales muscles, and corrugated or knit by the corrugatores supercilii. The *Eye-lids* are superior and inferior, of which the former is considerably the deeper. They are united by an inner and outer *commissure*, and the intervening aperture varies according to the separation of their margins. Their texture is constituted of muscle, fibro-cartilage, and common integument. The *Tarsal fibro-cartilages* support the eye-lids, and give form and thickness to their margins. The superior is much deeper than the inferior, and the border of each is thick, and corresponds to the curve of the globe. On their margins the conjunctive membrane terminates, and the orifices of the *Meibomian follicles* are seen. These glandular sacs are in linear arrangement on the borders of the tarsal cartilages; and external to them are the eye-lashes, *Ciliæ*, consisting usually of three rows, and longer and more numerous in the upper than the lower lid: they are curved, with their convexities towards each other. The Skin of the eye-lids is very delicate, and quite destitute of adipose tissue. The *Conjunctiva* is a reflected secreting membrane, more nearly allied to the mucous than any other class of membrane. It covers the internal surface of the palpebræ, and is reflected from them upon the sclerotic coat of the eye, to which it adheres. It cannot be raised beyond the margin of the cornea, whence it has been supposed by some anatomists that it is absent on this structure, an opinion which is scarcely substantiated by pathology. This membrane is continuous with that of the nasal fossæ, through the communicating ducts. A fold of the conjunctiva, named the *Caruncle*, occupies the inner angle of the eye; and another, of a semilunar form and indistinct, may be observed on the inner part of the globe. The *Lachrymal apparatus* consists of the gland, puncta, sac, and duct. The *Lachrymal*

Gland occupies the deep hollow of the upper and outer part of the orbit, behind the conjunctiva. It is of a greyish brown colour, composed of granules, and convex towards the orbit, but flattened on its ocular aspect. Its secretion is poured out by five or six small ducts, which open on the surface of the conjunctiva, where this membrane is reflected from the upper lid to the globe. The *Puncta lachrymalia* are the orifices of the ducts of the same name. They are placed opposite each other on an eminence of either tarsal cartilage, about two lines distant from the inner canthus; and they communicate with a small channel, which is formed between the above cartilages and the eye-ball when the lids are closed. Of the lachrymal *ducts* the superior is the longer and more curved, the inferior being short and nearly horizontal. They open into the *Lachrymal Sac*, which occupies a space formed for it at the union of the upper jaw and lachrymal bones. It is an oval membranous bag, which contracts below to communicate with the nose by the *Nasal duct*. The canal which lodges this duct is completed, in addition to the two bones first mentioned, by the os turbinatum. The duct itself is about three-quarters of an inch in length, and in its descent it inclines a little backwards and outwards. Its nasal orifice is oblique and valvular.

The *Muscles* of the eye-ball are four straight and two oblique. The *Recti* all arise around the optic foramen, the external likewise contracting an origin from the lacerated foramen of the orbit; they are severally named, according to their action, abductor, adductor, levator, and depressor oculi. The *Superior Oblique* muscle rolls the eye so as to direct the cornea downwards and outwards. The *Inferior Oblique* rotates the eye upwards and outwards. The two oblique muscles also antagonize the straight by drawing the eye-ball forwards. The muscles of the lids are, the *Levator Palpebræ Superioris*, which arises in common with the recti, and expands on the upper lid; and the *Orbicularis Palpebrarum*, which consists of a pale expanded fasciculus of fibres surrounding the eye, and spread beneath the skin of the eye-lids and that covering the adjoining part of the brow and cheek; its only fixed attachment is to the nasal processes of the frontal and superior maxillary bones, and to a small tendon (*Tendo Oculi*), which is connected to the latter bone and inner commissure of the tarsal cartilages, crossing in front of the lachrymal sac. This muscle closes the lids, directs the tears to the puncta, or expresses them on to the cheek. Other muscles of the forehead and face act on the integuments surrounding the orbit.*

Arteries.—The internal Carotid artery gives off a branch, which is destined especially for the supply of the eye. The *Ophthalmic* artery arises from the above-named trunk as it is placed beneath the anterior clinoid process of the Sphenoid bone. It enters the orbit by the Optic hole, at first lying external, and then superior to the nerve; it then proceeds obliquely forwards and inwards to the inner side of the orbit, crossing beneath the Levator palpebræ and oculi, and subsequently parallel to the Obliquus superior. While external to the Optic nerve it gives off a large branch, the *lachrymal*, which takes its course outwards to the lachrymal gland; this structure it supplies, and likewise the upper eye-lid. A small but important branch is also separated from the Ophthalmic artery in the above position, viz., the *Central* artery of the *Retina*: this penetrates the substance of the Optic nerve, and traverses its centre, emerging on the inner surface of the retina, the vascular coat of which it assists in forming; a twig from it pierces the vitreous humor and supplies the capsule of the lens. The *Supra-orbitar* branch is next detached, with the ciliary and muscular branches, when the artery is above the Optic nerve. The first of these runs forward close to the roof of the orbit to the supra-orbitar foramen, where it emerges, to terminate in the muscles and skin of the frontal region; in its course it aids in the supply of the ocular muscles. The *Ciliary* arteries are short and long: the former are very numerous, and surround the Optic nerve as they pass forwards to pierce the sclerotic; they subsequently traverse the choroid and ciliary circle, supplying each structure in their progress, and terminate in the iris. The long ciliary branches, which are two in number, take a similar course, one on either side of the Optic nerve, and likewise terminate in the iris. The arterial circles of the iris are formed by the above vessels. The *Muscular* branches supply the various muscles. The *Ethmoidal* branches leave the orbit by the internal orbitar foramina, and supply the ethmoidal cells, frontal sinus, and nasal fossa. The two *Palpebral* branches supply either eye-lid and the neighbouring lachrymal apparatus. The Frontal branch leaves the orbit near the notch for the oblique pulley, and supplies the muscles and skin of the forehead. The *Nasal* is the terminal branch; it accompanies the last named on to the forehead, and then passes inwards to the nose, where it anastomoses with the ultimate branch of the facial. The four last described leave the Ophthalmic artery whilst it is internal to the Optic nerve. In addition to the above main source, the appendages of the eye receive branches of supply from the facial, infra-orbitar, and temporal arteries. The *Veins* for the most part correspond to and take the same course as the arteries. The Ophthalmic vein terminates in the cavernous sinus.

Nerves.—The largest and most important of these is the *Optic*. It enters the orbit by the optic foramen, where it receives a strong coating from the dura mater: it then decreases in size, and inclines forwards and inwards, so as to perforate the sclerotic a little inferior and internal to the axis of the globe: the expansion of the retina has been already described. The appendages of the eye are supplied by sensitive nervous filaments from the fifth, and by three motor nerves. The *Ophthalmic* nerve, after leaving the Casserian ganglion, crosses the cavernous sinus between the fourth and sixth nerves, and then divides into three branches just prior to entering the orbit by the lacerated foramen. The frontal branch is the highest and largest, and runs forwards and inwards to the pulley of the oblique muscle, through which one of its filaments passes to the forehead,—the other escapes by the supra-orbitar foramen: they supply the frontal region, even to the vertex. The lachrymal nerve terminates in the gland of that name and upper eye-lid; in its course thither it communicates with the infra-orbitar nerve by the spheno-maxillary fissure, and sends a filament through the malar bone to join the facial. The Nasal branch enters the orbit between the heads of the abductor oculi muscle, and crosses to the inner side of this cavity, where it divides into an infra-trochleator

* For further particulars, see 'Muscular System,' p. 411.

Anatomy. branch which supplies the eye-lids and neighbouring skin; and a proper nasal, which enters the skull by the anterior internal orbitar foramen, and then descends with the olfactory nerve, as already described.* The third nerve is also named *Common Oculo-muscular:* it lies highest up in the cavernous sinus, and then bifurcates as it enters the orbit by the lacerated hole, where the nasal and lachrymal branches of the fifth are interposed between its divisions. The superior branch supplies the levator palpebræ and levator oculi; the inferior and larger is distributed to the depressor, adductor, and inferior oblique muscles. The fourth, or *Pathetic* nerve, mounts above the third as it enters the orbit, and terminates in the superior oblique muscle exclusively. In like manner the sixth, or *Abducent* nerve, which all along occupies the lowest position in its course, enters the ocular surface of the external rectus muscle, in which it is lost. The iris is supplied by nervous filaments from a small *ganglion*, named *Lenticular* or *Ophthalmic*. This little ganglion is placed on the outer side of the optic nerve, between it and the abducent muscle; it receives filaments of communication from the nasal nerve and inferior oblique branch of the third, and gives off, in common with the former, the ciliary nerves which accompany the arteries of the same name to the ciliary circle, and are distributed to the iris; this structure thus derives motor and sensitive, as well as sympathetic filaments, which latter join the nasal nerve prior to its communicating with the ganglion.

Physiology.—When rays of light, or undulations, are directed to the eye they impinge upon the retina, and are thence conducted by the optic nerve to the sensorium: the result is vision. The essential and fundamental part of this, as of the other senses, is, therefore, the nerve of specific sensation; the other constituents of the organ are for support and protection, and for qualifying the rays of light in their progress. It should be remarked that all our knowledge respecting the mode by which light impresses the retina is purely speculative.† The uses of each part of the organ of vision will be briefly considered. The eye-brow and lashes protect the eye by limiting, if needed, the quantity of light admitted, as well as by helping to exclude extraneous particles of matter. By the approximation of the eyelids the whole surface of the anterior part of the globe is covered or swept at pleasure; light may be thus excluded, and the exposed surface of the eye-ball moistened and cleansed. In this operation the upper lids descend three-fourths of the distance to meet the lower. The secretion by which the surface of the globe is moistened is derived from three sources; the lachrymal gland secretes the tears, the conjunctiva pours out its own peculiar secretion, and the Meibomian glands lubricate the margins of the tarsi. The superabundant fluid is usually conveyed to the nose through the puncta, lachrymal ducts and sac, and nasal duct; but under unusual circumstances, as in weeping, the copious and sudden secretion is poured out upon the cheek. The agency of mental influence on this little gland is remarkable and interesting, but equally unintelligible. The reflection of the conjunctiva from the lids to the eye-ball prevents extraneous particles from insinuating themselves behind the latter. The sclerotic membrane gives form and support to the eye. The prominence of the cornea is probably for the purpose of augmenting the sphere of vision; the rays of light undergo some refraction in their passage through this structure. The Aqueous humor is a second medium through which the rays proceed; but the principal use of this fluid is to preserve the equal convexity of the cornea (which collapses on its escape), and to allow of the free action of the floating iris. The Crystalline lens collects and rapidly concentrates the luminous rays, which have still to traverse a fourth medium, viz., the Vitreous humor; this last body also gives its spherical form to the globe, equally distending the tunics, and thus facilitating the different motions of the ball. The effect of the adaptation of these varied media to each other is to produce an achromatic instrument which corrects decomposition; whilst the diameter of the axis of the globe is so proportioned to the focal distance of the lens as to permit the image of an object to be justly formed on the retina. The choroid coat absorbs the transmitted rays of light; and the Iris, by its contraction or dilatation, augments or diminishes the pupillary aperture, and thus regulates the admission of light to the retina. The actions of the muscles moving the globe have been already described

* See 'Sense of Smell.'

† The reader is referred to the article 'Optics' for information on the nature and properties of light.

ANATOMY.

SECTION IV.

OF THE NERVOUS SYSTEM.

In the section which treats of the "Structure and Functions of the Nervous System," three distinct divisions have been noticed under the several titles of *Cerebral*, *True Spinal*, and *Sympathetic* or *Vegetative*. In the first and last of these, anatomists are enabled to identify structure with function; but the present state of knowledge does not supply the analogous connexion between the True Spinal or Excito-motory functions and their corresponding source or centre; in other words, there is as yet no satisfactory demonstration of the true seat of the functions last alluded to, although experiment leaves no doubt that a section of the spinal marrow constitutes the centre (or series of centres) of the Excito-motory system, and that filaments or offsets from this central source accompany most, if not all, of the spinal and some of the cerebral nerves in their course and distribution.* It has seemed desirable to introduce the present subject with the above prefatory remarks, in order to anticipate any misconstruction of the division which will be adopted in this the *Anatomical* description of the nervous system. Two sets of nerves, with their corresponding centres, will, therefore, present themselves for notice; viz., the Cerebro-spinal and Sympathetic; and the following order of description will be followed:—1. Cerebro-spinal System—*a.* Brain and its coverings; *b.* Spinal Cord and its coverings; *c.* Cerebral Nerves; *d.* Spino-sacral Nerves. 2. Sympathetic System—*a.* Ganglia; *b.* their branches.

The Brain is invested by three coverings, the Dura Mater, which is for support; the Arachnoid, which is a serous membrane; and the Pia Mater or vascular covering. The *Dura Mater* is a tough white fibrous membrane lining the Skull, of which it forms the internal periosteum, and to which it is more or less adherent at different parts, but especially so in the base and at the sutures. It lines the various apertures which transmit vessels and nerves in and out of the Skull; at these spots the dura mater becomes continuous with the external periosteum, which is likewise the case in the young subject at the sutures; it is also identified with the orbitar periosteum at the sphenoidal fissure; and a prolongation (to be presently described) accompanies the spinal marrow in its course through the vertebral canal. Certain folds or productions of the dura mater form septa between different parts of the brain, and at the same time serve the purpose of preserving from pressure the veins (sinuses) contained between their layers. The falx major or cerebri extends longitudinally between the hemispheres of the cerebrum, commencing narrow at the crest of the ethmoid bone, and extending to the internal occipital protuberance. The Falx cerebelli or minor is a continuation of the preceding forwards to the occipital foramen; it is interposed between the hemispheres of the Cerebellum. The Tentorium is a transverse partition separating the cerebrum from the cerebellum; it corresponds to the transverse grooves of the occipital bone and the superior angles of the petrous bones; a prolongation of the extremities of this fold along the small wings of the Sphenoid bone are called the Sphenoidal folds, and they correspond to the fissures of Sylvius. The principal arterial supply to this membrane is derived from the great meningeal branches of the Internal Maxillary Artery: they enter the Skull by the spinous foramina in the Sphenoid bone, and deeply groove the parietal bones in their course upwards and backwards to the vault of the Skull. Other and minor branches are derived from the internal carotid, ophthalmic, ascending pharyngeal, occipital, vertebral and posterior aural arteries, and enter the Skull by different foramina in its base. The *Sinuses* are venous canals contained between folds of the Dura Mater, and are constituted of this membrane externally, and the common lining membrane of the veins within; they are either single or in pairs. Of the single sinuses, the Torcular Herophili occupies a central position opposite the internal occipital protuberance. The superior Longitudinal sinus commences at the foramen cœcum of the ethmoid bone, and extends along the upper border of the falx to the Torcular, receiving in its course the veins from the surface of the cerebral hemispheres. The inferior longitudinal sinus is small, and occupies the concave border of the falx major; it collects blood from the corpus callosum, and terminates in the next. The Straight sinus corresponds to the base of the falx, and leads from the last to the Torcular; it receives the blood of the interior of the brain by the Venæ Galeni, and also branches from the cerebellum. The following sinuses are in pairs;—the Occipital run from the margins of the occipital foramen posteriorly to the Torcular. The lateral sinuses are capacious, and communicate between the Torcular and jugular veins; the bone is deeply grooved by them, and they correspond to the attached margin of the Tentorium as far forwards as the posterior lacerated foramen in the base of the Skull, where the jugular vein commences; they receive blood from both cerebrum and cerebellum. The Cavernous sinuses are placed on either side of the body of the Sphenoid bone, and the two communicate by two single sinuses, viz., the transverse sinus, which stretches across the basilar process of the occipital bone, and the circular, which surrounds the pituitary body. The superior Petrosal sinuses are a pair extending along the superior angles of the pe-

Anatomy.

* The only probable hypothesis hitherto broached upon the subject is that of Mr. Grainger, who believes he has discovered, in the *cineritious* substance of the cord, the True spinal centre.

trous bones between the cavernous and lateral sinuses: and the inferior Petrosal, which lie between the above-named bones and the occipital, have similar communications to the last. Some of the sinuses, especially the superior longitudinal, have fibrous bands stretched across their interior, apparently to limit their distention; and little granular bodies are developed about the orifices of the veins, probably to assist in directing the current of the blood.* The free communication of the sinuses and their incompressibility, as well as limited distensibility, are circumstances of vital importance to the integrity of the delicate organ with which they are connected.

The *Arachnoid* membrane invests the surface of the brain, sends a process into its interior, and lines the dura mater, to which it firmly adheres throughout its whole extent, except at the sella turcica. The visceral and parietal layers are continuous at the points of exit or entrance of the vessels and nerves. This membrane does not dip into the interstices of the convolutions, and is more loosely connected to the brain on its under than on its upper surface. The internal division of the Arachnoid communicates with the external at a small aperture (foramen of Bichat) placed between the posterior margin of the corpus callosum and the cerebellum, and thence spreads out beneath the veins of Galen and a fold of pia mater, denominated "velum interpositum," to be presently noticed: it also lines all the ventricles (except the fifth), traversing the apertures of communication between them. The perfect smoothness and lubrication of the opposed surfaces of this membrane are important properties in connexion with the organ it invests.

The *Pia Mater* or vascular membrane immediately invests the brain, not only covering its surface, but also lining the interstices between the convolutions: by this arrangement a very extended superficies of the cerebral structure is brought into direct contact with the net-work of vessels which constitute this delicate tissue. A reflection of the pia mater also spreads in the interior of the brain, through a broad fissure, which is bounded by the corpus callosum and pons Varolii in the centre, and extends between the thalamus and hippocampus major laterally: this is denominated "velum interpositum," and the margins are called "plexus choroides."

In the dissection of the encephalon its physical characters are found to differ at various parts, presenting in some places a reddish-brown, and at others a pearly-white appearance: these component structures are severally called cineritious and medullary. The former, or cineritious matter for the most part invests the latter, but the medullary exists in more abundance.

The bulk of the brain consists of a larger and smaller portion, named "Cerebrum" and "Cerebellum;" and each of these divisions is further divided into symmetrical halves by a longitudinal fissure, at the same time that they are united and connected by means of commissures which stretch from side to side: moreover the larger and smaller brain are joined to each other, and associated with the spinal cord by other commissures, which will be noticed in the course of the dissection. The longitudinal fissure which divides the *Cerebrum* into its two hemispheres is very deep, and lodges the greater falx. The superior surface of this division of the Brain corresponds to the vault of the cranium, and is consequently convex in each direction. The convolutions are irregular and variable in form, size, and direction, and are separated by deep fissures: these characters are less prominently developed on the under surface of the cerebrum. Each hemisphere is subdivided into lobes by a curved fissure (F. Sylvii); that portion resting beneath the tentorium has been called the posterior lobe, though undistinguished by any fissure similar to that which marks the separation between the anterior and middle lobes. The orbitar plates of the frontal bone support the anterior lobes, and the great wings of the sphenoid the middle. When the under surface of the cerebrum is viewed, it will be perceived that it is connected to a central protuberance (Pons Varolii) by two processes (crura), and these are crossed by bands of medullary matter (tractus optici), which unite anteriorly to form the optic commissure whence the nerves spring. In the diamond-shaped space thus bounded are seen two little pea-shaped bodies (corpora mammillaria), anterior to which the pituitary body is seen connected to the brain by a hollow peduncle named infundibulum, and behind them the medullary matter is pierced with vessels (locus perforatus). It has been remarked that the cerebral hemispheres are connected by commissures: there is, nevertheless, a considerable interspace, which has been described under the title of "Third Ventricle." The lower wall or floor of this inter-cerebral space is formed by the parts enumerated above as contained between the crura cerebri and optic tracts: its sides are formed by two bulbous swellings (optic thalami), which are connected by a short flat band of cineritious matter (soft commissure). By an aperture in its floor this fissure communicates with the infundibulum; and posteriorly, here is a passage leading beneath the optic tubercles to the grooved upper surface of the medulla oblongata (fourth ventricle). Covering in the inter-cerebral fissure is the membranous veil (velum interpositum) already described. Above this veil are found the three great cerebral commissures. When the cerebral hemispheres are separated, an extended mass of medullary matter is brought into view (corpus callosum): this consists of transverse fibres stretching into either hemisphere, and extending to their cineritious exterior: the extremities of this great transverse commissure are rounded or folded on themselves. Above this, and running along the margin of the longitudinal fissure on either side, are the fibres which connect the different lobes of each hemisphere together (superior longitudinal commissure). The Inferior longitudinal commissure (fornix) is interposed between the great transverse commissure and the veil of pia mater, and thus overhangs the central fissure called third ventricle: it consists of longitudinal medullary fibres, splitting before and behind, but united in the centre: the anterior pillars descend in front of the middle ventricle, and terminate in the corpora mamillaria and crura cerebri; whilst the posterior are found investing certain convolutions in the posterior lobes (hippocampi). A double vertical layer of medullary matter (septum lucidum) connects the transverse with the inferior longitudinal commissure: the intervening fissure is called "fifth ventricle." In front of the anterior pillars of the fornix, a rounded band of medullary matter extends between two pyriform bodies (corpora striata);

* The reader is referred back to this description, when studying the organization of the brain.

this is the anterior commissure. Behind the third ventricle are the optic lobes, four in number (nates and testes); upon the upper surface of which is resting a little grey body (Pineal gland), connected by peduncles to the optic thalami; and anterior to this is the posterior commissure, uniting the optic thalami at their junction to the optic lobes. Processes of medullary matter proceed from the last-named bodies into the interior of the cerebellum, constituting commissural bands between the great and small brain and spinal cord: the inner borders of these are connected by a thin plate called "Valve of Vieusseus." If the interior of the cerebral hemispheres be examined, their folded arrangement will be found to produce the appearance which has given rise to the description of lateral ventricles or cavities within the brain. Here, on either side of the median fissure, are seen the anterior and posterior cerebral ganglia (corpora striata and thalami nervorum opticorum), which are severally denominated the "ganglia of motion and sensation." They are partly overlapped by the borders of the velum interpositum (plexus choroides), and present in the interval between them a narrow band of medullary matter (tænia semicircularis). In the posterior extremity of the lateral ventricle, so-called, is a small convolution, denominated "hippocampus minor;" and a larger one (hippocampus major) lies in that part of the fissure which communicates with the base of the brain: the inner border of the latter is sharp and free (tænia hippocampi). The broad transverse or horizontal fissure, with the vertical or inter-cerebral fissure, establish a communicatiom between the lateral and middle ventricles.

The structure of the *Cerebellum* presents an analogous arrangement to that already described in the Cerebrum, as regards the relative position of the medullary and cineritious matter; but in place of convolutions, the surface presents a series of lamellæ or plates separated by fissures, which admit the pia mater. A similar disposition also exists of division into symmetrical hemispheres, which are connected by commissures. Of these, one extends along the posterior aspect of the cerebellum, projecting into the great fissure above and below, and known by the name of "Vermiform processes;" the other is more distinctly commissural in its character, consisting of transverse fibres which constitute the superficial part of the mesocephalon (*Pons Varolii*) and the crura cerebelli. It may be here observed, that the interior of the Pons presents the longitudinal fibres of the motor and sensory tracts, passing from the cord to the cerebral hemispheres by the crura cerebri. In the last-named bodies these tracts are separated by grey matter of a very deep colour (*locus niger*). The interior of the cerebellum exhibits the relation of its component structures, of which the medullary is derived from three sources—viz., the inter-cerebral commissures, the great transverse cerebellar commissure, and the posterior columns of the cord. Recent dissection has also shown that the anterior columns likewise contribute some fibres.* A vertical or horizontal section of the cerebellum exhibits the appearance termed "arbor vitæ," the distribution of the medullary interior in its cineritious capsule presenting an arborescent arrangement, whence the name. An irregular oval line of the dark, within the white, matter has received the name of corpus dentatum.

* Solly, *On the Brain*, p. 157.

The *Spinal cord* is connected to the brain above under the title of "Medulla oblongata," and terminates in the upper lumbar region by forming the "cauda equina." Its coverings are continuous with those of the encephalon, the dura mater and arachnoid being both more loosely connected to the canal and cord than they are to the skull and brain. The fibrous membrane leaves the foramina with the Spinal nerves, and then becomes continuous with the adjoining cellular membrane. The arachnoid is reflected from the nerves at their exit, and forms a cul-de-sac or tubular prolongation in the sacral canal. The investing membrane of the cord, though continuous with the pia mater, is very different in texture and consistence, being tough, dense, and resisting; it is also more sparingly and less uniformly vascular than the cerebral pia mater. A line of angular fibrous processes descends, under the name of "Ligamentum dentatum," between the roots of the Spinal nerves. The superior is the most expanded part of the cord, which also presents other swellings opposite the origin of the brachial and lumbar nerves. In form the medulla spinalis is cylindrical, and, with the above exceptions, gradually diminishes in size as it descends; and first forming at its lower extremity an oval expansion, then terminates in a short conical process, which is surrounded by the cauda equina. There are six longitudinal grooves or fissures in the Spinal cord—two median and four lateral. The former are deep, the latter shallow. Of the median fissures the anterior is the deeper, and the two cut the cord so as to give it the appearance of two rounded columns placed side by side, and flattened where they are in contact. The bottom of the anterior sulcus presents transverse medullary fibres. The anterior and posterior lateral grooves are very shallow, and mark the lines of origin of the double roots of the spinal nerves. The relation of the white and grey matter in the cord is transposed, the former enveloping the latter. The medullary matter exceeds the cineritious in quantity, and the latter exists in greater abundance in the cervical and lumbar regions—a fact which seems to support the hypothesis of a connexion between this structure and the true spinal centre, as it is from these spots that the largest nerves spring. The form of the cineritious interior of the cord presents, on transverse section, the appearance of two crescents, with their convexities looking inwards and connected. Either half of the medulla spinalis is divided into anterior and posterior columns, or the columns of motion and sensation. As these ascend they are divided above in the medulla oblongata by an interposed eminence of grey covered by white matter, named "corpus olivare." In this, the upper extremity of the cord, the anterior pillars are called "pyramidal," and the posterior "restiform" bodies. The lumbar and sacral nerves take a long course from their origin before they emerge from the vertebro-sacral canal; the resulting appearance is the "cauda equina."

Cerebro-spinal Nerves.—All the nerves arising from the brain and spinal cord are in symmetrical pairs, and their usual form is cylindrical. With but few exceptions they take a direct course to their destination, very rarely deviating in their origin, or importantly so in their distribution. The "anastomoses" of nerves are frequent, whether with their fellows, with others possessing similar functions, or those of a different character. Where this interlacement is complex, it is designated

by the title "Plexus." It should ever be borne in mind that the anastomoses of nerves consist in a simple interchange of fibrils; in no instance is the identity of a single ultimate filament lost throughout the whole of its course.

Cerebral Nerves.—Under the above head are included all the nerves originating from the brain and upper part of the spinal cord, with the exception of the sub-occipital; and these are generally classed into "pairs," according to their association at their exit from the skull. It need scarcely be remarked that this classification is most unscientific; but it imports little to the student who is first made acquainted with the above fact, and has, at the same time, placed before him a classification founded upon the stricter principle of their physiology. This will be first attempted in the following tabular view, which may be referred to in the succeeding description of the nerves under the numerical appellations by which they are generally known.

Classification of Cerebral Nerves according to their functions:—

Simple. .	Specific Sensation	1st, or Olfactory.
		2nd, or Optic.
		Auditory division of 7th.
	Motion . . .	3rd, 4th, 6th, 9th.
		Facial of 7th.
Compound	Sensation and motion. . .	8th.
	Sensation, motion, and specific sensation . . .	5th.

Probably all of the above belong, either as Excitors or Motors, to the True Spinal or Excito-motory System.

The first pair of Cerebral Nerves, or *Olfactory*, are connected to the posterior margin of the anterior lobes of the cerebrum. Each nerve has three attachments,—an internal to the fore and under part of the corpus callosum; an external, which extends along the fissure of Sylvius; and an intervening central peduncle. The resulting ganglion, rather than nerve, is prismatic in form, and lies in a groove on the under surface of the anterior cerebral lobe, and expands into an oval bulbous enlargement as it lies on the cribriform plate of the ethmoid bone, just prior to the descent of its filaments through the foramina in this bone.*

The *Optic* nerves, or second pair, take their cerebral origin from the tubercula quadrigemina by two distinct bands, which join corresponding elevations on the Optic thalami, known by the name of "corpora geniculata." A flat white band (*tractus opticus*) results from the union of these fibres, which takes its course downwards, forwards, and inwards, around the crus cerebri of the same side; and gradually assuming a cylindrical form, the aggregated fibres converge, and ultimately unite on the olivary process of the sphenoid bone to form the optic commissure, whence the nerves proceed to their destination. Prior to this union a few delicate fibres connect the optic tract to the tuber cinereum. The commissure is not uniform in its structure and the relation of its component fibres, but there is usually a distinct interchange of filaments between the nerves of either side at their point of contact.

* For the *distribution* of this and other nerves connected with the Senses, the reader is referred to that head.

The Third pair of nerves are called *common Oculo-muscular.* They are connected to the motor tract at the inner margin of each crus cerebri, near its junction to the mesocephalon. They take their course between the posterior cerebral and superior cerebellar arteries towards the cavernous sinus, resting on the attachment of the tentorium to the posterior clinoid process of the sphenoid bone. All the ocular muscles, except two, are supplied by these nerves.

The fourth pair, or *Pathetic*, spring from the inferior of the optic tubercles (testes) at their junction to the plate which connects the inter-cerebral processes (valve of Vieusseus). They wind round the crura cerebri, and emerging between the cerebrum and cerebellum each nerve follows the concave border of the tentorium and pierces the dura mater, to enter the cavernous sinus at a point a little external to the third nerve.

The fifth pair of nerves are also styled *Trigeminal*, from their threefold destination. They are types of the spinal nerves, consisting of two roots, a non-ganglionic or motor, and a ganglionic or sensitive origin. Of these roots, the former is anterior and smaller, and derives fibres from the motor tract in the crus cerebri, whilst the posterior and larger division may be traced back through the pons to the interval between the olivary and restiform bodies at the summit of the spinal cord. Each perfect nerve then passes to the petrous bone, on the point of the superior angle of which a depression exists, in which it is lodged. In its passage thither the small white bundle of fibres is covered by the broad, flat, fascicular division which constitutes the posterior root. This latter terminates on the point of bone above mentioned, in a large greyish-red semilunar ganglion, the concavity of which faces backwards and inwards. From the convexity of this, the Casserian Ganglion, three nerves proceed, severally denominated Ophthalmic, Superior, and Inferior Maxillary. The motor root retains its independence as it passes beneath the ganglion, and then joins the inferior maxillary nerve. The Ophthalmic nerve soon enters the cavernous sinus, and there receives filaments from the superior cervical ganglion of the sympathetic prior to its ultimate division. The superior Maxillary nerve is somewhat larger than the Ophthalmic division, and passes forwards and outwards to the round hole in the sphenoid bone, by which it escapes from the skull; it then crosses the spheno-maxillary fissure to the infra-orbitar canal, along which it takes its course, and emerging on the cheek divides into its ultimate filaments. The branches of this nerve are divided into three classes, according to their points of origin: 1. In the spheno-maxillary fossa the orbitar branch is separated, which enters the orbit by the spheno-maxillary fissure, and divides into a temporal and malar twig: the former pierces the upper part of the malar bone to arrive at the temporal fossa, where it communicates with filaments from the inferior maxillary nerve, and terminates in the skin of the temple; the latter escapes also through the malar bone to terminate on the cheek. Two short vertical filaments next descend from the superior maxillary nerve to join the spheno-palatine ganglion. Immediately afterwards the posterior superior dental are given off; they wind round the tuberosity of the upper jaw, which they perforate, to supply the molar teeth, a few filaments being given to the gums and periosteum. 2. Whilst in the infra-orbitar canal the anterior superior dental are separated; they

descend along the anterior wall of the antrum (which they supply), and terminate in the incisor, canine, and bicuspid teeth of the upper jaw. 3. The terminating branches of the nerve emerge from the canal by the infra-orbitar foramen, and are distributed relatively to the regions denoted by their names—Malar, Nasal, Palpebral, and Labial. The Inferior Maxillary, or largest division of the trifacial nerve, passes out of the skull by the oval hole of the sphenoid bone; it is then found lying in contact with the external pterygoid and tensor palati muscles, and may be seen to consist of two distinct portions,—the anterior and external being the non-ganglionic white root already noticed, whilst the other and larger part partakes of the characters common to it and the other divisions of the nerve already described. The branches of the motor root are exclusively distributed to the muscles of mastication, and are the following: temporal filaments, which cross the external pterygoid muscle to gain the temporal fossa, where they terminate in the temporal muscle, and by communicating in the scalp with the facial nerve. The Masseteric also crosses the external pterygoid muscle, and then runs between it and the temporal to terminate in the masseter, after supplying the temporo-maxillary articulation. The Buccal takes its course between the internal pterygoid muscle and ramus of the jaw to the buccinator muscle, crossing first the coronoid process; it gives filaments to the pterygoid and temporal muscles, and then terminates in the buccinator: sometimes a separate branch or branches supply the pterygoid muscles. The sensitive or ganglionic division of the nerve divides into three branches. The Temporo-auricular passes backwards behind the neck of the lower jaw, and then upwards between its condyle and the external auditory opening; after which it issues from the parotid gland, and accompanies the temporal artery in its divisions: its filaments are distributed to the external ear, glenoid articulation, and skin of the temple, where it communicates with the facial. The Inferior Dental branch first runs between the pterygoid muscles, and then between the pterygoideus internus and ramus of the jaw to the inferior dental hole: prior to entering the canal a filament is separated, named mylo-hyoidean, which supplies that muscle, the digastric, and the submaxillary gland. In the dental canal filaments are distributed to the several teeth of the lower jaw, a large division of the nerve being separated at the mental foramen, where it emerges, and terminates in the muscles, skin, and mucous membrane of the lower lip and chin. The Lingual branch at first accompanies the last described, but separated from it by the internal lateral ligament of the lower jaw; it then descends obliquely behind the last molar tooth to the interval between the sub-maxillary gland and mucous membrane of the mouth, and joining the duct of the former crosses the insertion of the hyo-glossus muscle and above the sub-lingual gland, to terminate on the tongue. The filaments this distributes in its progress are, to the internal pterygoid muscles, to the mucous membrane of the mouth, the tonsils, gums, side of the tongue, and upper part of the pharynx; its termination has been already described. *Physiology.*—The Fifth is a compound nerve of motion and sensation, differing only from the spinal nerves in the non-amalgamation of their separate roots. The motor portion of the nerve superintends the acts of mastication, whilst the posterior root becomes the sensitive nerve of the forehead, face, tongue, palate, &c.; and its lingual branch appears also to be the nerve of taste. Each division appears further connected relatively with the excitor and motor functions of the true spinal system.

The sixth pair, or *Abducent* nerves, spring from the upper extremity of the pyramidal bodies of the medulla oblongata, at their junction to the mesocephalon. Each pierces the dura mater to enter the cavernous sinus just behind the posterior clinoid process of the Sphenoid bone; and, in its course through the sinus, is closely applied to the outer side of the carotid artery, where it receives filaments of communication from the carotid plexus of the sympathetic. It supplies the abductor muscle of the eye.

Under the head of seventh pair of cerebral nerves, two are classed together which have nothing in common save their aperture of exit from the skull—the Portio mollis, or *Auditory* nerve, and Portio dura, or *Facial.* The former is connected, at its cerebral extremity, to the upper part of the medulla oblongata by two sets of fibres enclosing the restiform body, the posterior of which may be seen in the form of transverse white lines crossing from the grooved fissure of the cord (the fourth ventricle). These converging filaments are collected at the angular junction of the mesocephalon with the crus cerebelli and corpus restiform, whence the nerve proceeds to the internal auditory foramen, which it enters accompanied by the portio dura. The Facial nerve arises from the upper part of the motor tract of the cord at its junction to the mesocephalon, emerging external and posterior to the fifth and sixth nerves; it is usually connected, soon after its origin, by a few filaments to the auditory, anterior to which it lies. In the internal auditory passage the facial is the internal of the two, and soon quits its consort to enter the aqueduct of Fallopius, which it traverses, and makes its exit by the stylo-mastoid foramen. Whilst in the aqueduct the muscular filaments to the tympanum are separated, and, immediately after leaving the skull, the three following branches are given off: Posterior auricular, which winds before the mastoid process to divide into twigs, which are distributed to the concha, auricular, occipito-frontalis, and sterno-mastoid muscles; the Sub-mastoid enters the posterior belly of the digastric muscle, which it supplies, also communicating with branches of the par vagum; the Stylo-hyoid branch supplies the Styloid muscle, and communicates with the superior cervical ganglion. The facial trunk now takes its course downwards and outwards through the parotid gland, and, whilst still imbedded in its structure, bifurcates immediately after crossing the external carotid artery, close to its ultimate division: the resulting branches are severally named temporo-facial and cervico-facial, and the interlacement from subsequent interchange of filaments is the parotidean plexus (Pes anserinus). The temporo-facial division is the larger; it passes upwards through the structure of the parotid gland, and, crossing the condyle of the lower jaw, subdivides into temporal, malar, and buccal branches: the first of these supplies the temporal, frontal, and auricular muscles, and communicates with the other nerves in these regions; the malar twigs cross the bone of that name, to supply the muscles of the cheek and upper lip; the buccal are transverse, crossing the masseter with the parotid duct, and supplying the muscles of the upper

lip, alæ nasi, and commissure of the lips; many filaments also communicate with the motor and sensitive portions of the fifth on the cheek. The Cervico-facial division of the facial trunk passes downwards through the parotid to the angle of the lower jaw, where it subdivides into supra-mental filaments, which supply the muscles of the lower lip, and the infra-mental, which run beneath the platysma, giving it filaments, and communicating freely with the cervical plexus. *Physiology.*—The Facial nerve is the motor nerve of the face, supplying those regions which derive their sensitive filaments from the fifth. It belongs to the motor section of the true spinal system.

The eighth pair of nerves consists of three divisions, which are classed together as they pass out of the skull in company. The *Glosso-pharyngeal* and *Pneumogastric* divisions arise by several filaments from the side of the medulla oblongata between the olivary and restiform bodies: they are joined by the third division, which is really a spinal nerve, arising from the spinal marrow by several filaments between the pneumogastric and fourth spinal nerve; it is the *Spinal accessory*. These three pass together to the posterior lacerated hole of the skull, by which they quit this cavity anterior to the jugular vein, the pneumogastric being placed between the other two nerves. The Glosso-pharyngeal first sends off a tympanitic branch which traverses the petrous bone to join the Vidian; and communicating also by other filaments with the facial and sympathetic, it takes its course around the stylo-pharyngeus muscle to its destination, which has been already described. The Pneumogastric nerves, or Paria Vaga, consist, at their origin, of eight or ten distinct fascicles belonging to either nerve, which, at their exit from the skull, are closely bound together and intimately connected to the lingual motor nerves. Each par vagum then presents a greyish gangliform enlargement, and subsequently pursues its course through the neck and chest to the abdomen. In the cervical region it lies upon the rectus capitis anticus and longus colli muscles, and in the carotid sheath between the artery and jugular vein. The right nerve then crosses the subclavian artery at right angles (being interposed between it and the vein), to pass into the thorax: the left nerve is on a plane posterior to its fellow, and descends between the subclavian and carotid arteries of that side, parallel to which it runs to gain the outer surface of the descending portion of the arch of the aorta. The two nerves then approach the median line, and pass behind the roots of the lungs into the posterior mediastinum, where they attach themselves to the œsophagus, and are conducted by it (the left being on its anterior, and the right on its posterior aspect) through the diaphragm to the stomach. *Branches.*—After communicating with the other neighbouring cerebral nerves and superior cervical ganglion of the sympathetic, the pharyngeal branch is separated, which descends obliquely inwards behind the carotid sheath, and close to the spine towards the pharynx: a plexus is here formed by this branch and other filaments from the glosso-pharyngeal and sympathetic, which supplies the pharynx. The superior laryngeal branch is given off almost immediately afterwards, and takes a similar course behind the carotid sheath to the side of the larynx, where it divides into external and internal filaments: the former are distributed to the thyro-hyoid, sterno-thyroid, and crico-thyroid muscles; the latter penetrates the thyro-hyoid membrane, and is distributed to the mucous lining of the larynx, and crico-thyroid and arytænoid muscles. The Vagus then communicates with the cervical plexus, and gives off its cardiac filaments (one on the left and three or four on the right side) to join the cardiac plexus, whither they are conducted by the carotid arteries. The recurrent laryngeal branch is given off whilst the nerves are relatively connected to the under part of the subclavian artery and upper part of the aortic arch, the former being encircled by the right and the latter by the left nerve; each recurrent branch then passes upwards and inwards under the carotid and inferior thyroid arteries and thyroid gland to the pharynx, beneath the inferior constrictor of which it takes its course to gain the posterior aspect of the thyroid cartilage: it communicates with the cardiac plexus and inferior cervical ganglion, supplying also the thyroid body and tracheal mucous membrane: its terminating filaments pierce the crico-thyroid membrane, and are distributed to the crico-arytænoideus lateralis and posticus, and thyro-arytænoideus, as well as the mucous membrane of the larynx, where it communicates with the superior laryngeal nerve and its fellow. Behind the root of each lung the great pulmonic plexus is formed by a net-work of filaments derived from the pneumogastric nerves (which here for a time almost lose their cord-like character), and from the lower cervical and first thoracic ganglia: similar but fewer filaments are detached to form an anterior pulmonic plexus in front of the pulmonary vessels: the branches from these plexus accompany the ramifications of the bronchi and terminate in their lining membrane. A similar plexiform arrangement may also be observed on the œsophagus, the filaments from which supply this tube. Lastly, in the abdomen these nerves form a network around the cardiac extremity of the stomach, from which filaments proceed, under cover of the peritoneum, to supply all parts of this organ, and to communicate with the neighbouring sympathetic plexus supplying the abdominal viscera. *Physiology.*—These nerves regulate, through their laryngeal branches, the muscular movements of the larynx, and are therefore essential to the production of voice; they further endow the mucous membrane of the laryngeal orifice with its very exalted sensibility. By their pulmonic branches, the pneumogastrics convey impressions from the lungs to the brain, whence the necessary motor influence is propagated along the phrenic nerves to regulate the movements of the Diaphragm. The cardiac branches preserve the sympathy between the heart, lungs, brain, and stomach: such is likewise the property of the gastric branches in part, though doubtless they are also necessary to the perfect performance of the functions of this organ, which are principally under the control of the sympathetic system. Probably the sensations of hunger and thirst are also referable to these nerves.

The Spinal accessory nerves ascend from their origin between the roots of the spinal nerves, and lie, in the lacerated foramina, behind the other divisions of the eighth, and to the outer side of the ninth: on emerging from the cover of the jugular vein, each nerve almost immediately perforates the sterno-mastoid muscle obliquely, and again appears on its posterior aspect, where its ultimate filaments are distributed to the trapezius muscle. It communicates in its course with the pneumo-gastric, lingual motor and cervical nerves, and

supplies the sterno-mastoid muscle. *Physiology.*—These nerves control the actions of the muscles they supply, being also motor branches of the true spinal system.

The ninth, or *Lingual Motor* nerves, spring by ten or twelve distinct filaments from the motor column in the medulla oblongata, emerging from the fissure between the corpus olivare and pyramidale of either side. Each nerve descends outwards to the anterior condyloid foramen in the occipital bone, after which it becomes closely connected to the par vagum, being posterior to it and to its inner side. It subsequently hooks round the occipital artery, and crossing external to the carotid arteries and vagus nerve, it passes beneath the digastric and stylo-hyoid muscles in its progress to the tongue. It communicates with the pneumogastric, sub-occipital, and cervical nerves, and superior cervical ganglion, and gives off a long branch, called Descendens Lingualis. This nerve runs down the neck parallel to the carotid artery, and generally superficial to its sheath: it is usually reinforced by a branch from the vagus, and opposite the point of intersection of the sterno-mastoid and omo-hyoid muscles, it is met by communicating twigs from the cervical nerves, and a little triangular plexus is the result, from which filaments proceed to be distributed to the omo-hyoid, sterno-hyoid, and sterno-thyroid muscles. This descending branch of the lingual nerve probably associates the actions of the muscles it supplies with those between the lower jaw, larynx, and tongue.

Spino-Sacral Nerves.—Under this head thirty pairs of nerves are classed, which escape from the vertebral canal by the spinal and sacral foramina. Their most prominent characteristics are that they are symmetrical; that they commence by double roots, of which the posterior is considerably the larger, and swells into a ganglion prior to joining the anterior; of these roots (which spring by several filaments from the lateral furrows of the cord), the former is exclusively sensitive and excitor, and the latter is endowed with motor properties. As these roots are passing the intervertebral foramen, and immediately subsequent to the formation of the ganglion on the posterior, they unite into a single cord or trunk, which again divides into anterior and posterior branches, of which the former is almost invariably the larger; the nerves, after this division, are composed of the mixed roots, and are, therefore, compound nerves of motion and sensation. In the upper region of the spine the nerves are nearly transverse in their direction as they leave the column; but they gradually become more oblique, and have a longer course within the spinal canal as the sacral region is approached.

The *Cervical* nerves are eight in number, of which the first emerges beneath the occipital bone (sub-occipital), and the last below the seventh vertebra of the neck.

The *posterior* branches of these nerves pass backwards between the transverse processes of the vertebræ to supply the posterior cervical muscles. The first two are, however, larger than the anterior branches, and require separate notice. The superior passes into the triangular space bounded by the posterior recti and obliqui muscles, to which and others in the neighbourhood it is distributed. The second nerve passes back between the superior oblique and complexus muscles, and after giving off a lash of muscular filaments, it is continued upwards in the scalp even to the vertex.

The *anterior* branches of the first four cervical nerves, after communicating with each other, coalesce to form the *Cervical plexus.* The situation of this plexus is in the posterior superior triangle of the neck, between the second and fifth cervical vertebræ, covered by the platysma and posterior border of the sterno-mastoid muscle, and lying internally on the anterior scalenus, and externally on the levator anguli scapulæ muscles; its branches are superficial and deep. The ascending *superficial* branches are three;—the auricularis, which ascends to the interval between the angle of the lower jaw and ear in company with the external jugular vein, and is lost in the parotid gland and external ear, where it communicates with the facial vein. The superficialis colli ascends towards the sub-maxillary gland, which it supplies, and likewise gives filaments to the platysma and digastric muscle, and to communicate with the facial and mylo-hyoidean nerves. The mastoid branch keeps the posterior border of the Sterno-mastoid muscle, and is lost in the occipital scalp and ear. The descending superficial branches are supra-clavicular and acromial; these take the directions their names denote, and are lost in the skin of the chest and shoulder. The *deep* branches communicate with the descending lingual nerve, and give off the muscular filaments already described (see ninth cerebral nerve); others descend beneath the clavicle to terminate in the axilla; of these, one long branch (external Respiratory of Bell) is connected with the phrenic and distributed to the Serratus magnus muscle. Lastly, the *Phrenic* nerve descends from the cervical plexus; it is derived from the third and fourth nerves, and gets an additional filament from the upper cord of the brachial plexus. This descends obliquely over the anterior scalenus muscle to its inner magin, being interposed in this course between the sub-clavian artery and vein. As it enters the chest it hooks round the internal mammary artery, and then crossing anterior to the root of the lung, it descends between the pericardium and pleura to the diaphragm. The left nerve is somewhat longer, and on a plane posterior to the right, having to wind round the apex of the heart. The scalenus muscle usually receives a filament from this nerve; but its destination is the diaphragm, of which it is the motor nerve, thus completing the excito-motor circle with the pneumogastric or centripetal nerve. Filaments from the Phrenic nerve pierce the diaphragm to join the abdominal plexus of the Sympathetic. In addition to the communications above noticed, the anterior branches of the upper cervical nerves communicate with the Sympathetic ganglia in the neck, and with the eighth and ninth cerebral nerves.

Brachial Plexus.—The anterior branches of the four inferior cervical nerves much exceed in size those of the superior, and passing outwards between the scaleni muscles, unite with the anterior branch of the first dorsal to form the plexus which supplies the upper extremity; prior to this union, muscular filaments, especially from the fifth and sixth nerves, are distributed to the anterior cervical muscles, levator scapulæ, serratus magnus, latissimus dorsi, and pectoral muscles; and communicating filaments are received by each from the cervical ganglia of the Sympathetic. Of the branches which constitute the brachial plexus, the upper descend to join the lower, which are nearly horizontal, and three nervous cords result from this union; the superior, consisting of the fifth and sixth

cervical, the middle of the seventh alone, and the eighth cervical and first dorsal nerve forming the inferior cord. The position of this plexus is in the posterior inferior triangle of the neck, above and a little behind the subclavian artery, being sometimes separated by a portion of the posterior scalenus muscle; it then descends outwards between the subclavius muscle and first rib, to enter the axilla, where it next lies on the upper digitation of the serratus magnus. The nerves then surround the artery and pass to their several destinations.

The Branches of this plexus are Thoracic, Scapular, and Brachial. The *Thoracic* nerves are two or three in number, and descend before the vessels to be distributed to the pectoral muscles; they come from the inferior part of the plexus, and communicate with the second intercostal nerve. The *Scapular* nerves vary in number: the supra-scapular is a large regular branch which passes from the upper part of the plexus to the superior costa of the scapula, where it traverses the foramen completed by ligament, and subsequently descends beneath the acromion to terminate in the infra-spinatus and teres minor muscles: a subscapular branch is separated before the nerve arrives at the supra-spinous fossa, and filaments are given to the muscle of that name in the last-mentioned space. The subscapular nerves are irregular; they accompany the corresponding artery in its distribution to the subscapular and teretes muscles. The *Brachial* branches are large and numerous; they are related in the following way to the artery: the two heads of the median nerve join anterior to it; the inner cutaneous and ulnar are connected to the internal head of the last, and therefore lie to the inner side of the artery; the outer cutaneous is in like manner connected to the external head of the median, and the radial and circumflex nerves are behind the artery. The Circumflex nerve leaves the upper part of the plexus to join the posterior circumflex artery in its exit from the axilla between the humerus, long head of the triceps, and latissimus dorsi muscles; it runs round the neck of the bone under cover of the deltoid muscle, to which it is principally distributed; some filaments supply the joint, teres minor and infra-spinatus muscles, and others become cutaneous. The internal Cutaneous nerve proceeds from the lower part of the plexus, and accompanies the basilic vein beneath the fascia of the arm to the inner condyle, where its branches become cutaneous. After supplying the skin about the elbow, the internal or larger division of the nerve continues its course in company with the basilic vein, distributing its filaments to the anterior, inner, and back part of the fore-arm as low as the hand; the outer division is similarly disposed of on the anterior and external part of the fore-arm. Usually another small cutaneous nerve exists, which is joined by communicating filaments from the second and third dorsal nerves (Wrisberg's), and is distributed to the skin of the axilla and inner brachial region. The External or Musculo-cutaneous nerve leaves the middle of the plexus, and shortly perforating the coraco-brachialis muscle, descends between the flexors of the fore-arm to the elbow, where it becomes sub-cutaneous; then, after crossing under the median cephalic vein, it traverses the fore-arm, and divides into anterior and posterior branches. In the above course it supplies the muscles with which it is in contact and the skin of the fore-arm, and its terminating filaments are lost in the skin of the thumb and that covering the second metacarpal bone. The Ulnar nerve is derived from the inferior cord of the plexus; it descends between the triceps and biceps muscles, in company with the inferior profunda artery to the inner condyle of the humerus, behind which it passes, and between the two heads of the flexor carpi ulnaris muscle; it then passes through the fore arm under cover of this muscle, and lying upon the deep flexor of the fingers to the inner side of the ulnar artery: it subsequently crosses superficial to the annular ligament to terminate in the palm. In the upper arm this nerve gives a few filaments to the triceps and neighbouring integument; in the fore arm it supplies many of the flexor muscles of the fingers: a large dorsal branch is separated about the middle of the fore arm, which winds round the ulna, and descends upon the extensor carpi ulnaris to the back of the hand, where it is distributed to the skin of the little and ring fingers. Of the terminating branches the superficial is the larger, supplying the palmar surface of the little finger and ulnar side of the ring finger; and communicating with the median, the deep branch passes between the abductor minimi digiti and long flexor tendons, supplying the muscles of the thumb and little finger, and anterior interossei. The Median nerve collects branches from all parts of the plexus, and after the union of its two heads it descends in front of the brachial artery, gradually inclining to its inner side as they together approach the elbow; it then passes deeply into the fore arm between the supinator longus and pronator teres, separating the two heads of the latter muscle, and taking its subsequent course between the superficial and deep flexors of the hand; at the carpus it is seen between the flexor sublimis and flexor carpi radialis, and passing beneath the annular ligament it divides into its terminal branches. This nerve distributes large filaments to the flexors and pronators in the fore arm: an interosseous branch accompanies the corresponding artery for the supply of the deep flexors; it pierces the interosseous ligament below, and terminates on the back of the hand. The median then gives off a cutaneous palmar filament above the wrist, and divides into its digital branches, which are five in number: these cross the palm, and run in company with the digital arteries on either side of the thumb, fore finger, and middle finger, as well as the radial side of the ring finger, where a communication is established with the ulnar: the muscles of the thumb and lumbricales are also supplied by these branches. The Radial nerve is generally the largest of the plexus, from which it arises by several filaments from each of the cords; it takes a spiral course round the humerus, piercing the fibres of the triceps, between the inner and middle heads of which it first runs, and then between the outer head and bone; it is accompanied by the superior profunda artery, and near the elbow is found between the long supinator and anterior brachial muscles, where it divides into an anterior and posterior branch. In its course this nerve supplies the extensors of the fore arm, and extensors and supinators of the hand; and above its division a cutaneous branch (radial cutaneous) is separated, which descends on the outer and back part of the fore arm to the wrist. Of the terminating branches the anterior is the smaller; it accompanies the radial artery through the middle third of its course, and then winds close to the radius to the back of the fore arm: it is lost on the skin of the thumb, fore and

middle fingers. The posterior branch of the Radial nerve takes a deep course, piercing the supinator brevis close to the neck of the radius: it first supplies the extensor and supinator muscles, and subsequently descends on the posterior aspect of the interosseous ligament to the posterior annular ligament, beneath which it passes to be distributed to the dorsal interossei muscles and skin of the hand.

The *Dorsal Nerves* are twelve pairs, the last of which leaves the spinal canal between the last dorsal and first lumbar Vertebræ. The posterior branches in this region pass backwards between the transverse processes of the vertebræ and superior costo-transverse ligaments, and are distributed to the muscles and skin of the back and loins, the last communicating with the first lumbar. The anterior branches are the intercostal nerves, each of which receives, soon after its origin, one or two communicating filaments from the corresponding sympathetic ganglion of the chest. As the intercostal nerves pass outwards, they first lie beneath the pleura, and subsequently insinuate themselves between the intercostal muscles, and accompany the intercostal vessels in the groove on the under border of each rib: they terminate by dividing into internal and external branches. The former of these, after supplying the intercostal muscles, are distributed to the skin and muscles of the chest and mamma above, and to the abdominal muscles and integument below; the latter pierce the external intercostal muscles near the middle of the ribs, and terminate in the serratus magnus and abdominal muscles. The first intercostal nerve is the largest, assisting in the formation of the brachial plexus. The second and third give off the cutaneous brachial branches already noticed. The twelfth communicates with the first lumbar. Their length corresponds to the length of the ribs, and their position in the costal groove is superior to the artery.

The *Lumbar Nerves* are five pairs, of which the lowest leaves the spinal canal immediately above the sacrum. The posterior branches are distributed, as those in the dorsal region, to the lumbar muscles. The anterior branches communicate with the lumbar sympathetic ganglia, with each other, and with the last dorsal and first sacral nerves. The Lumbar plexus results from the union of these branches; it is imbedded in the psoas muscle, and rests on the transverse processes of the lumbar vertebræ. The following are the branches of this plexus: the Ilio-scrotal crosses the quadratus lumborum muscle to the crest of the ilium, and then piercing the transversalis muscle divides into two branches; one of these is distributed to the oblique muscles and skin of the buttock; the scrotal branch gains the internal ring, and is distributed to the groin and scrotum. The external Cutaneous nerve of the thigh pierces the abdominal parietes obliquely, and, emerging near the spine of the ilium, is distributed to the skin of the back and outer part of the thigh as low as the knee. The Genito-crural nerve passes beneath Poupart's ligament, and divides into an external spermatic branch, which is lost in the cord and scrotum, and a crural branch which supplies the groin and skin of the thigh. The Anterior Crural nerve is a large branch of the plexus, from different parts of which it is formed; after emerging from the psoas muscle, it descends between it and the iliacus, and beneath the fascia to the crural arch, through which it runs external to the femoral artery. The above muscles first receive filaments from this nerve, which then divides into superficial and deep branches: the former, three or four in number, pierce the fascia a little below Poupart's ligament, and are distributed over the skin of the thigh even to the knee. The deep branches are external, internal, and descending: the first of these are most numerous, and supply the extensors of the leg, the tensor vaginæ femoris and iliacus; the internal are lost in the vastus internus, pectinæus, and sartorius; and the descending are two,—the small saphenus, which supplies the lower part of the vastus internus and sartorius, between which it runs; and the great saphenus, which accompanies the femoral artery, lying on its outer side, to the opening in the adductor magnus: here this long nerve quits the femoral vessels, and accompanies the anastomatic artery round the inner condyle between the tendons of the sartorius and gracilis; and in the rest of its course it is found close to the internal saphena vein, with which it passes anterior to the inner malleolus to terminate on the dorsum of the great toe: it gives off two or three muscular filaments in the thigh, besides supplying the knee-joint and neighbouring skin. The Obturator nerve is derived principally from the third lumbar; it crosses the pelvis, between the fascia and peritoneum, to the opening in the thyroid membrane, where it escapes with the corresponding artery to terminate in the obturator and adductor muscles: one or two filaments become cutaneous. The Lumbosacral nerve is the last and largest branch of the plexus; it soon divides into two branches: the superior gluteal, which leaves the pelvis above the pyriform muscle, and is distributed to the two smaller glutei muscles; and the communicating branch, which crosses the gluteal artery to join the ischiatic plexus.

The *Sacral Nerves* are usually five pairs, the inferior leaving the canal between the sacrum and coccyx; the posterior branches are distributed to the skin of the nates and anus, and the anterior unite to form the Sciatic plexus. This large flattened band of nerves rests behind the pelvic viscera on the side of the sacrum and pyriform muscle, and becomes united into a single large cord at its exit from the pelvis; it presents no interlacement, but a simple junction of component trunks: the branches are visceral and femoro-crural. The former receive the names of Hæmorrhoidal and Vesical, and, in the female, Uterine and Vaginal are superadded; they are distributed with the branches of the Hypogastric plexus of the Sympathetic, accompanying the ramifications of the internal iliac artery. The Pudic nerve accompanies the artery of the same name in its course round the spine of the ischium; on re-entering the pelvis by the lesser ischiatic hole it divides into a superior and inferior branch: the former is guided by the rami of the ischium and pubes to the arch of the latter, beneath which it runs to gain the dorsum penis; its gives filaments to the urethra, muscles, and integuments, and terminates in the glans penis: the inferior, or perinæal branch, becomes superficial by passing between the erector penis and accelerator urinæ, and is lost in the perinæal and urethral muscles and integument: in the female, the former of these branches terminates in the clitoris; the latter in the labia, nymphæ, and pubic skin. The Femoro-crural branches of the sacral plexus are the small and great Sciatic nerves. The former of these springs from the middle and lower parts of the plexus, and leaves

the great ischiatic hole above the pyriform muscle, when it divides into three branches: one, the inferior glutæal, is distributed to the great glutæus muscle; the second, or musculo-cutaneous, passes beneath the ischial tuberosity, and divides into filaments which supply the great glutæus muscle and the skin of the perinæum and inner region of the thigh; the posterior cutaneous is the largest and most external branch, which, after quitting the cover of the great glutæus, descends beneath the fascia to the ham, and here terminates in a lash of cutaneous filaments, having previously supplied other parts of the skin in its course. The great Sciatic nerve consists of the chief bulk of the plexus; it leaves the pelvis with the last described, although in some instances of high bifurcation the pyriform muscle is pierced by one division of it. The nerve then crosses in turn the gemelli, obturator, and quadratus muscles, and in its subsequent course through the thigh it lies on the adductor magnus near its insertion, and is overlapped by the hamstring muscles: the above muscles receive a few filaments from the nerve in its passage, and in or above the ham it divides into the two popliteal branches. The External of these is the smaller, and is directed by the biceps over the back of the outer condyle of the femur and head of the gastrocnemius muscle; it then winds beneath the long peroneus muscle round the neck of the fibula, in which short course it gives off muscular, cutaneous, and articular filaments, and one long branch (*communicans peronei*) which descends beneath the fascia to join a similar branch from the internal popliteal nerve; the terminating branches of the external popliteal nerve are the musculo-cutaneous and anterior tibial. The former, which is the larger, descends beneath the long peroneus, and between it and the long extensor of the toes; after leaving the former it continues to be covered by the crural fascia, which it pierces below the middle of the leg, and the rest of its course is cutaneous; it supplies the muscles with which it lies in contact, as well as the skin of the ankle and instep, and muscles and skin of the great toe, and then terminates by supplying the opposed margins of all the toes. The anterior Tibial nerve quits the last described beneath the peroneous longus, and gains the interosseal space by perforating the common extensor of the toes; it then descends in company with, and to the outer side of, the anterior tibial artery, being between the anterior tibial and common extensor muscles above, and between the former and extensor of the great toe below; and lastly, after passing beneath the annular ligament and tendon of the extensor pollicis, it is found between the latter and long extensor tendon. It gives filaments to the above-named muscles and knee-joint, and its terminating filaments supply the short extensor and dorsal interossei muscles, and the opposed borders of the first and second toes. The Internal Popliteal nerve takes a vertical course through the ham, posterior to the vessels and popliteus muscle, and covered by the fascia; it then passes deeply beneath the soleus muscle and deep fascia of the leg, and thence descends, under the name of posterior Tibial nerve, to the inner malleolus, where it bifurcates. In this course it lies to the outer side of the corresponding artery, and in succession upon the posterior tibial and long flexor muscles; in the lower fourth of the leg it is only covered by fascia. The first branch of this nerve is the communicans tibialis, which accompanies the smaller saphena vein down the leg, and, being joined by the communicans peronei, the resulting nerve is called posterior saphenus; it runs behind the outer ankle, to the skin of which it gives filaments, and ultimately terminates in the muscles and skin on the outer side of the little toe, and on the opposed margins of it and the fourth toe. In the ham, large muscular branches are separated from the internal popliteal nerve for the supply of the posterior muscles of the leg and of the knee-joint; lower down, the deep muscles of the leg receive their supply, and a communicating filament usually traverses the interosseal space to join the anterior tibial nerve; a few cutaneous twigs are likewise separated, and one regular branch is given to the skin of the heel and sole of the foot; lastly, the division into the plantar nerves takes place close to or beneath the origin of the adductor pollicis muscle, and behind the vessels. The inner plantar, which is the larger, runs above the adductor pollicis to the space between it and the flexor brevis; after supplying the plantar muscles it divides into four branches, which are distributed to the tibial side of the great toe and the opposed margins of the four inner toes. The external plantar nerve crosses the foot obliquely between the flexor brevis and accessorius muscles to the base of the fifth metatarsal bone; after giving off muscular filaments it here divides into a superficial branch which supplies both margins of the little toe and the outer border of the fourth, which latter communicates with the inner plantar; and a deep branch which crosses above the abductor pollicis, and terminates in the lumbricales, plantar interossei, and other deep plantar muscles.

Sympathetic or Vegetative System of Nerves.—This system consists of many sources of nervous influence, which are scattered over different parts of the head and trunk, and branches of communication and distribution which are offsetts from these ganglia. Those of the head will be first described.

Ophthalmic Ganglion.—(*See* ' Organ of Vision.)

Spheno-palatine Ganglion (of Meckel).—This ganglion is found in the pterygo-maxillary fossa, between the tuberosity of the upper-jaw and pterygoid process of the sphenoid bone on either side. From it two small filaments ascend to join the superior maxillary nerve. The inferior or palatine nerve descends through the posterior palatine hole to terminate in the arch of the palate and gums; a nasal filament passes from it through the palate-bone; and others supply the velum, uvula, and tonsils. The spheno-palatine branches pass inwards through the foramen of that name to the nasal fossa, in the mucous membrane of which most of them terminate; and one long filament is conducted by the nasal septum to the anterior palatine foramen, where a small ganglion is found (*naso palatine*), and whence filaments are distributed to the palate. The Vidian or recurrent branch passes backwards through the pterygoid foramen, and, after communicating with the carotid plexus, enters the skull by the anterior lacerated hole, and penetrates the petrous bone by a small foramen, which communicates with the Fallopian aqueduct; here it joins the facial nerve, on the under part of which it runs for a short distance, and then quits it to cross the tympanum (under the name of *corda tympani*), between the incus and malleus: it subsequently leaves this cavity by the glenoid fissure, and, joining the lingual branch of the fifth

nerve, quits it at the posterior margin of the submaxillary gland, and terminates in the *submaxillary ganglion* by which the gland is supplied.

The *Otic Ganglion* is situated on the inner side of the submaxillary nerve just after the latter has quitted the skull: it distributes filaments to the tensor palati, internal pterygoid, and tensor tympani muscles; communicating with the sympathetic filaments on the external carotid artery, and with the third division of the fifth; and also giving off a filament which penetrates the petrous bone.

The *Superior Cervical Ganglion* is elongated in form, thick in the centre, and tapering at the extremities. It extends longitudinally over the second and third cervical vertebræ, resting on the anterior rectus muscle, and covered immediately by the internal carotid artery. Its ascending branches accompany the internal carotid artery, forming a plexus around it, and communicating with the Vidian nerve, the nasal branch of the fifth and the sixth nerves: one or two small ganglia may be remarked in tracing these filaments to their ultimate destination. A descending branch communicates with the middle ganglion of the neck, and aids in forming the cardiac plexus, likewise communicating with the cervical nerves. The anterior branches communicate with the seventh, eighth, and ninth nerves, and accompany the carotid and its branches. The external branches are large, and establish a free communication with the cervical plexus. Lastly, the internal branches supply the anterior cervical muscles, and join the pharyngeal and laryngeal plexus.

The *Middle Cervical Ganglion* is frequently absent, but when present is usually opposite the fifth cervical vertebra, of a rounded form, and lying between the carotid sheath and longus colli muscle. It communicates with the superior and inferior cervical ganglia, and the upper branchial nerves near their origin; it gives off a cardiac branch, and filaments to the thyroid body, trachea, and œsophagus.

The *Inferior Cervical Ganglion* is irregular in size, being larger in the absence of the last, and frequently coalescing with the first thoracic ganglion. Its position is between the transverse process of the last cervical vertebra and the head of the first rib, close to the vertebral artery. Besides its communicating branches with the ganglia above and below, and with the lower brachial nerves close to their origin, it sends filaments to join the pulmonary and cardiac plexus, and to accompany the mammary and scapular branches of the subclavian artery.

The *Cardiac Plexus* is a title given to an interlacement of nervous filaments between the bifurcation of the trachea and arch of the aorta. This plexus contains many small ganglia in its meshes, and receives the cardiac branches of the pneumogastric nerves, already described, as well as the three pairs of cardiac filaments from the cervical ganglia: these latter branches are irregular, and not symmetrical. On the right side, the superior cardiac nerve descends behind the carotid trunk to enter the chest between the subclavian vein and artery close to its origin: the middle nerve on the same side is large, and when the middle ganglion is absent, it springs from the connecting branch of the upper and lower ganglia, and crosses the subclavian artery external to the last: the inferior nerve of the right side passes behind the subclavian artery into the chest. On the left side, the superior cardiac nerve takes a deep course between and parallel to the subclavian and carotid arteries, by which it is conducted to the aorta; the middle filament is often absent on this side, its place being supplied by a larger inferior branch, which runs by the side of the subclavian artery to the aortic arch. The superior cardiac nerves communicate with the branches of the par vagum and lingual mótor nerves. The principal destination of the branches of the cardiac plexus is to the structure of the heart, which they penetrate in company with the coronary arteries, posteriorly and anteriorly; some of the former filaments also accompany the pulmonary vessels to join the pulmonic plexus, and thus aid in supplying the lungs.

The *Thoracic Ganglia* are generally twelve pairs, the first pair being frequently identified with the lowest cervical. Their form is irregular, but usually triangular or ovoid, and as large as a grain of barley: their position is on, or a little below, the head of each rib, and they are covered by the pleura reflected from the sides of the posterior mediastinum. The branches of these ganglia are few, consisting of a communicating filament between those which are neighbours, and one, or sometimes two, which direct themselves upwards and outwards to join each intercostal nerve; irregular and small filaments join the pulmonic plexus, but the most important branches are those which constitute the splanchnic nerves. It should be further noticed that the first and last thoracic ganglia communicate relatively with the last cervical and first lumbar ganglia; and that the communicating filaments between the several ganglia of the chest cross the intercostal vessels. The *Splanchnic* nerves are great and small: the former arises by about five filaments from the thoracic ganglia between the sixth and tenth inclusive, which unite to form a single cord on either side of the body of the eleventh dorsal vertebra: this enters the abdomen by penetrating the corresponding crus of the diaphragm, and is usually separated from the aorta by a few muscular fibres. The small splanchnic nerve is similarly formed from the last two thoracic ganglia, or from the tenth and eleventh: it perforates the diaphragm external to the last.

The *Semilunar Ganglia* are a pair, and placed immediately below the diaphragm, resting on its crura, and against the aorta, close to the origin of the cœliac axis. They are equal in size to a horse-bean, the right being, with rare exceptions, the larger; the vena cava and renal capsule cover the right, and the pancreas and splenic vessels the left ganglion. Each ganglion receives the corresponding great splanchnic nerve, and the two are intimately connected by a network of thick filaments, to which the name of *Solar plexus* has been given. This plexus is of considerable extent: it lies upon the aorta, and receives communicating branches from the pneumogastric nerves. From this primary plexus the following secondary plexus are derived, viz., the phrenic, gastric, hepatic, splenic, superior, and inferior mesenteric. A separate account of these is unnecessary, as they are merely named according to the viscera they supply, and whither they are conducted by the appropriate arteries; they communicate more or less with each other and with the pneumogastric nerves.

The *Renal Plexus* is situated close to each renal artery, and receives the small splanchnic nerves and filaments from the semilunar and one or two of the

lumbar ganglia; they give branches (*supra renal*) to the renal capsules, and others which accompany the vessels of the testicle (*spermatic*) to this organ, the secreting structure of which it is presumed they supply; in the female the ovary receives them. The principal portion of each renal plexus passes with the emulgent artery into the kidney.

The *Lumbar Ganglia* are five pair, similar in size to the thoracic: they lie on the anterior border of the psoas muscle at its attachment to the bodies of the lumbar vertebræ, being covered severally on the right and left sides by the vena cava and aorta. These ganglia communicate with each other, with the last thoracic and first sacral ganglia, and the anterior lumbar nerves: filaments also join the hypogastric plexus.

The *Sacral Ganglia* are usually four or five pairs, and are placed near the anterior sacral foramina: they communicate with each other and with their fellows, as also with the sacral nerves and last lumbar ganglion. The principal filaments form the *Hypogastric plexus*, in company with branches from the sciatic plexus: this network of nerves surrounds the internal iliac arteries, and accompanies its branches in their distribution to the pelvic viscera. A single ganglion is found on the coccyx (*ganglion impar*), which communicates with the last pair of sacral ganglia.*

Anatomy.

* For the physiology of this system the reader is referred to the Article 'Nervous Tissue, its Structure and Functions.'

ANATOMY.

SECTION V.

ORGANS OF DIGESTION.

In treating of the various organs by which the nutritious parts of the food are extracted and distributed over the system, and by which the excrementitious or refuse portion is separated and disposed of, the ensuing order will be followed as best adapted to a consistent view of the physiology of the assimilative system; the organs of Ingestion and Digestion, including both glandular and membranous chylopoietic viscera, will be first described; then the organs of Circulation and Respiration, with the Absorbent System; and, finally, the Urinary System. The anatomy of the organs of Generation will partly accompany and partly follow the last division of this extensive subject. It may be further premised, that the structural or minute anatomy and physiology of each system will succeed the description of the organs which constitute it, *i. e.*, wherever such detail has not been anticipated in an earlier part of the work; in which latter case the necessary references will be given.

Mouth, Pharynx, Œsophagus.—The food is received into the mouth for comminution and admixture with the saliva and mucus. This cavity, which may be described as of an ovoid form, is bounded above by the hard and soft palate, and below by the tongue; the teeth, strictly speaking, form the lateral and anterior boundaries of the oral *cavity*, when they are approximated and in contact with the surrounding soft parts; but as the vertical diameter of the mouth is subject to varied degrees of extension, according to the depression of the lower jaw, so likewise, under those circumstances, the lips and cheeks more directly assume their true relations of its lateral and anterior walls. The bony portion of the superior wall is composed of the palatine plates of the superior maxillary and palate bones, whilst the pendulous or soft palate presents a central depending process named the uvula, and a lateral production of mucous membrane which bifurcates above the tonsil, and is connected before and behind this bundle of glands to the side of the root of the tongue and the pharynx: these folds severally contain the muscles named palato-glossus and palato-pharyngeus. The cheeks and lips are composed of common integument (much loaded with fat in childhood and youth) externally, and of mucous membrane within: enclosed between these laminæ is the buccinator muscle on either side, and the muscles pertaining to the lips anteriorly. The position of the tonsils has been noticed: they consist of an aggregation of mucous follicles, with open mouths on either side of the isthmus faucium. The mucous membrane of the mouth is continuous with that of the pharynx and larynx.*

The various apertures or outlets which the mouth presents are the following: the anterior or labial, surrounded by the lips and their commissures; posteriorly, the isthmus of the fauces, surrounded by the palate above, the tongue below, and the fauceal pillars on either side; at the upper and back part of the cheeks, nearly opposite the upper second molar tooth of either side, is the opening of the parotid duct; also beneath the tongue, on either side of the frænum linguæ, are the openings of the ducts of the submaxillary and sublingual glands. The present would seem the proper place to describe these, the salivary glands.

The organs which secrete the *saliva* are placed symmetrically in pairs on either side of the face and neck. The largest is the *Parotid*, so named from its proximity to the ear; it occupies the interval between the vertical ramus of the lower jaw and external auditory canal, extending upwards as high as the Zygoma, downwards to a level with the angle of the jaw, backwards to the sterno-mastoid muscle, and forwards over the ramus of the jaw and masseter to a greater or less extent: its external surface is nearly flat, and thin towards its anterior margin; whilst, in its deep connexions, it is related to the vertical ramus of the jaw and auditory canal, the glenoid cavity and styloid process of the temporal bone, and capsule of the temporo-maxillary articulation; it lies upon the internal carotid artery, jugular vein, and eighth and ninth cerebral nerves. The external carotid artery bifurcates in the substance of this gland, which also contains the corresponding veins, the plexus of the facial nerve, and branches of the third division of the fifth cerebral, and of the cervical nerves. The Parotid, as likewise the other salivary glands, belongs to the class of conglomerate glands, and is enveloped in a dense fibrous tunic, which is derived from the cervical fascia, and which also invests the individual lobules of the gland: a strong process of fascia, named stylo-maxillary ligament, usually separates the parotid and sub-maxillary; but in some instances all the Salivary glands on one side form one continuous chain. The Duct of the Parotid (Steno's) springs from its anterior margin near its upper border; it crosses the masseter muscle horizontally, being usually accompanied by a process of the gland (*socia parotidis*), and penetrates the buccinator muscle and mucous membrane of the cheek very obliquely, to terminate as already noticed; the calibre of this duct is very small, but its walls are dense. The *Submaxillary* gland is intermediate in size between the Parotid and Sublingual: it is of an irregular spherical form, lying

* For the anatomy of the tongue and its muscles, as well as those of the palate, cheeks, and lips; and for the teeth, and especial anatomy of the mucous membrane, the reader is referred to the several heads, 'Senses,' 'Muscular System,' 'Osseous System,' 'Mucous Membrane.'

under cover of the horizontal ramus of the jaw, and in the concavity formed by the curve of the digastric muscle: it is covered superficially by the platysma and cervical fascia, and rests on the mylo-hyoid and hyoglossus muscles; having above and to its outer side the internal pterygoid muscle, and stylo-maxillary ligament, which separates it from the parotid; the lingual gustatory nerve lies above this gland, and the facial artery and vein penetrate its substance. The Duct of the Sub-maxillary gland (Wharton's) is much thinner, but of larger calibre, than that of the Parotid: it leaves the gland to wind above the mylo-hyoid muscle, and terminates, as already noticed, by the side of the frænum linguæ, its length being about two inches. The *Sublingual* is the smallest of these glands, and is placed near the median line, being separated from its fellow by the genio-hyo-glossi muscles alone; it lies close beneath the tongue, and in contact with the mucous membrane in this region: this small gland has several ducts which open beneath the tongue on either side of the frænum.

The *Pharynx* is the first part of the alimentary tube into which the food is received from the mouth. It is composed of muscle externally, and of mucous membrane within; and its extent is from the base of the skull to near the middle of the neck, where it terminates in the œsophagus. It is connected by its muscles (already described*) to the skull, face, tongue, and larynx; and its mucous membrane is continuous with that of the mouth. Its surrounding relations are, posteriorly, the cervical vertebræ and anterior spinal muscles, on which it rests; and laterally, the carotid sheath and its contents: its anterior wall may be said to be absent, where it communicates with the mouth and nasal fossæ. On either side of the last-named openings are the expanded orifices of the Eustachian tubes, which look forwards and inwards: behind the base of the tongue, and protected by the epiglottis, is the orifice of the glottis; and still further back and inferiorly is the œsophageal opening.

The *Œsophagus* is a continuation of the pharynx, communicating between it and the stomach. It commences about the fifth cervical vertebra, and takes nearly a vertical direction, deviating at first a little to the left of the median line, and again more abruptly so prior to its perforating the diaphragm. Its relations in the cervical region are, anteriorly the larynx, trachea, and thyroid body; posteriorly, the vertebræ and longus colli muscle; and laterally, the carotid sheath. In the thorax it lies between the trachea, left bronchus, and pericardium anteriorly; the bodies of the dorsal vertebræ, the aorta and thoracic duct behind, and the lungs on either side. The left vagus nerve is connected to its anterior, the right to its posterior surface. The muscular structure of the œsophagus is divisible into two laminæ, the external of which consists of longitudinal fibres; the deeper layer is composed of annular fibres, which are less dense than the superficial. The mucous lining of the œsophagus is continuous with that of the pharynx and stomach.† It may be here noticed that the ultimate constitution of the Pharyngeal and Œsophageal muscular fibres places them amongst those which are distinguished by transverse stripes, a character common to all the voluntary muscles: in many instances, however, it has been observed that the unstriped fibres are found, to the exclusion of the former, in the lower half of the œsophagus, or mingled with them to an uncertain extent.

Abdomen.—This large oval cavity, as it is called, is placed between the chest above and the pelvis below; the principal part of its parietes are soft and muscular. Posteriorly, it is bounded by the lumbar vertebræ, the crura of the diaphragm, the psoæ and quadrati lumborum muscles; anteriorly and laterally, by the abdominal muscles, properly so called; and above, the diaphragm forms the septum between it and the chest: inferiorly, the abdomen and pelvis are continuous, the plane of division corresponding to the margin of the latter. The contents of the abdomen are the chylopoietic and glandular urinary organs, together with the large vessels and nerves destined for their supply, or traversing the cavity to their destination. The different regions into which the abdomen is divided are indicated by imaginary lines stretching transversely and perpendicularly between the following points: the cartilage of ninth rib on either side; the anterior superior spine of either ilium; and vertical lines from the former two points to the latter. From this division nine spaces result, which have received the following names: in the median line above, the epigastrium, bounded laterally by the right and left hypochondriac regions; the central region is subdivided into umbilical and right and left lumbar regions; and the inferior division comprises the hypogastric and right and left iliac regions. Before describing the viscera individually it will be necessary to pay attention to the serous membrane which invests them.

The *Peritoneum* partakes of the character common to all the true serous membranes, viz., that of being a closed sac, and consisting of a reflected and investing or visceral portion. The use of the membrane, in this as in other instances, is to allow of a free gliding motion of the viscera, which are in contact with each other or with the parietes of the containing cavity; its surface is, therefore, highly polished and lubricated by its proper secretion. Some of the viscera are wholly covered by the peritoneum, and others only partially so; a condition which is regulated by the degree of mobility of the invested viscus: thus, the greater part of the membranous chylopoietic viscera are wholly enveloped in the serous membrane, whilst the more fixed and glandular viscera are in many instances only partially surrounded. The reflexion of the peritoneum is somewhat complicated by the existence of an inner sac or bag called the great omentum, which communicates with the general serous sac by a constricted orifice named the foramen of Winslow. In following the layer which forms the larger or external sac, it is found to line the anterior and lateral wall of the abdomen, and may be traced into the pelvis, where it is reflected over the summit of the bladder to its posterior aspect, and where a cul-de-sac exists between that viscus and the rectum in the male: in the female the uterus, Fallopian tubes, and ovaries are interposed between them, and receive an investment from the peritoneum, which descends for a considerable distance on the posterior aspect of the vagina. From the rectum the peritoneum spreads laterally into either iliac fossa, where it partially covers the cœcum and sygmoid flexure of the colon; and, passing back to the spine in

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* See 'Muscular System, Pharyngeal Region.'

† For particulars respecting the mucous membrane in this and other regions, reference may be made to the head 'Mucous Membrane,' amongst the elementary tissues.

the middle line, it forms the under surface of the root of the mesentery, and expands laterally into the lumbar regions to cover the right and left portions of the colon and surface of the kidneys, prior to becoming continuous with the parietal portion. From the spine the peritoneum is conducted by the vessels to the small intestines, which are entirely invested in this way, except the duodenum; and the membrane is then conducted back to the spine, above the vessels, to form the upper surface of the root of the mesentery. From this point the layer in question may be traced again descending to invest the transverse arch of the colon posteriorly, and to form the outer lamina of the great omentum: from the free border of this sac the peritoneum ascends loosely in front of the arch of the colon, and thence over the anterior surface of the stomach, the spleen, and upper part of the duodenum; it next lies upon the vessels passing between the stomach and liver, by which it is conducted to the latter organ, and is thence reflected over both its surfaces. In its passage from the convex surface of the liver to the diaphragm it is intercepted by the ligamentous remains of the umbilical vein, and thus forms the broad or suspensory ligament of this viscus: similar reflexions of the peritoneum from the posterior border of the liver are named the lateral ligaments, and likewise attach it to the diaphragm. Thus are the various parts of this great serous sac found to be continuous. It has been observed that the bag of the great omentum communicates with the general peritoneal cavity by a foramen: the position of this opening is behind the hepatic vessels, below the lobulus candatus of the liver, and above the commencement of the duodenum; and from this constricted aperture the membrane is reflected in the following way. It descends in close connexion with the hepatic vessels, and is by them conducted to the posterior surface of the stomach, which it invests, and thence descends loosely over the transverse colon to the reflected margin of the omentum, which is generally lower on the left side than on the right. The posterior layer descends to meet that just described, crossing in its passage the middle and inferior divisions of the duodenum, the pancreas, the aorta, and vena cava ascendens. The several names given to various portions of the peritoneum included in the preceding description are the following:—the smaller omentum, enclosing the hepatic vessels; the gastro-splenic omentum, connecting the stomach and spleen; the transverse, right and left lumbar meso-colons, attaching the several divisions of the colon; the mesentery, connecting the small intestines to the spine; the meso-cœcum and meso-rectum, binding the cœcum and rectum to the right iliac fossa and sacrum.

The *Stomach* is the first and most dilated portion of the membranous digestive viscera in the abdomen: it communicates by its two extremities with the œsophagus and duodenum, and is liable to considerable alteration in size and form, as well as change of position, according to its degree of distension. In form, the stomach is conical and curved, so that it presents two surfaces, two curvatures and two extremities for examination: its greatest diameter is transverse. The anterior surface looks forwards and upwards, and is overlapped by the left lobe of the liver, whilst the posterior surface is less convex, and looks downwards and backwards: the greater curvature is convex, and faces forwards and downwards, corresponding to the transverse meso-colon: the smaller curvature is concave, and is directed backwards and upwards. The great or cardiac extremity of the stomach forms a cul-de-sac projecting beyond the œsophagus, and corresponding to the left hypochondriac region of the spleen: the smaller extremity, named the pyloric, is continuous with the commencing portion of the duodenum, and lies in the epigastric region. It has been remarked that the œsophagus pierces the diaphragm to the left of the median line: this opening is muscular, and is separated from the aortic aperture by the decussation of the crural fibres. This tube immediately afterwards terminates abruptly in the stomach, about one-third from its left extremity. The pyloric orifice is situated at the extreme right of the stomach, between the liver and pancreas, and immediately to the left of the gall-bladder: it presents a thickened feel to the touch, which is dependent on an annular arrangement of fibrous tissue between the muscular fibres, which are here aggregated in considerable quantity, and the mucous coat, which presents a reduplication, sometimes called the pyloric valve. Of the three tunics which constitute the stomach, the serous and mucous have been already described: the muscular coat is interposed between them, being pale in colour, and arranged in three laminæ. The superficial layer is continuous with the external œsophageal fibres, and exhibits a longitudinal arrangement, which is most apparent along the curvatures: the annular fibres lie immediately beneath these, and are most distinct in the middle and towards the small extremity: lastly, beneath the circular, there is an irregular layer of oblique fibres, which are found extending over the surfaces and great extremity of the Stomach. A dense layer of cellular tissue connects the muscular and mucous coats.

The *Small Intestine* is divided into three portions, severally named Duodenum, Jejunum, and Ileum. The first division, or *Duodenum*, is short, large, and fixed in position, though capable of considerable distension. In its course it describes a curve which extends from the pylorus to the root of the mesentery, and which encloses the head of the pancreas. The commencement of this curve is called the superior transverse portion, which is directed backwards and to the right side, and lies in the right hypochondriac region: the central portion takes a vertical direction downwards in front of the right kidney and vena cava, and therefore lies in the right lumbar region; having attained its lowest point, the intestine now proceeds upwards and to the left side, in front of the aorta and behind the superior mesenteric artery, to terminate in the jejunum: this division is called its inferior transverse portion. The duodenum, in the above course, extends over a space corresponding to the first three lumbar vertebræ: its superior abrupt turn corresponds to the under surface of the liver and neck of the gall-bladder, with the bile from which it is usually found tinged after death: the common gall-duct and that from the pancreas perforate the intestine obliquely, and open close together or by a common aperture at its lowest point. The serous investment of the duodenum has been already described as completely surrounding its superior division, and only covering the anterior surface of its remainder; from which arrangement it results that the superior transverse portion is the most moveable. Its muscular coat consists almost exclusively of annular fibres, which are strong and distinct. The mucous coat presents an

abundance of those prominent folds named valvulæ conniventes, which project into the interior of the intestine, and are arranged in the form of arches or segments of circles. A prominent papilla marks the point of entrance of the ducts already alluded to; and the obliquity of their perforation is probably a sufficient protection against the risk of regurgitation from the intestine.

The *Jejunum* commences at the termination of the duodenum, and the *Ileum* terminates abruptly in the cul-de-sac by which the large intestine commences. The distinction between the lower two divisions of the small intestine is purely arbitrary, two-fifths being assigned to the former and three-fifths to the latter; the distinguishing characteristics of the extremities of each being blended in the interval. The jejunum and ileum occupy the umbilical, hypogastric, and part of the iliac, lumbar, and pelvic regions; but as their convolutions are perfectly free and moveable, the extent of space they occupy of course varies according to their degree of distension: the great omentum forms a sort of apron which descends in front of them, and in fat people quite conceals them. These divisions of the alimentary tube are smaller than any other part, and, taken as a whole, it slightly diminishes in size as the cœcum is approached. The most fixed points are the commencement of the jejunum and termination of the ileum, which latter is situated in the right iliac fossa. It has been said that these intestines are surrounded by peritoneum, unless indeed the line of reflection of the serous membrane be excepted: the mobility of these viscera is further secured by the length of the mesentery between the spine and intestine: it may be also remarked, that the two laminæ which form this division of the peritoneum enclose the mesenteric glands and vessels, and conduct the arteries, veins, and lacteals to and from the intestine. The muscular coat of the jejunum and ileum consists of a double layer of pale weak fibres; the external being longitudinal and most distinct on their convex border, and the internal annular, but irregular and interrupted. The mucous coat is pale, and exhibits an abundance of valvulæ conniventes at the commencement of the jejunum, but the lower part of the ileum is destitute of them.

The *Large Intestine* is divided likewise into three portions named Cœcum, Colon, and Rectum. The *Cœcum* occupies the right iliac fossa, and presents the appearance of a large bulging cul-de-sac, in the left side of which the ileum abruptly terminates, and from the superior part of which the commencement of the colon ascends. It is bound in its position by a reduplication of the peritoneum, which surrounds it more or less in different subjects, and attaches it to the iliacus and psoas muscles: superficially, it is in contact with the anterior abdominal parietes. From its lower and back part hangs a cylindrical closed process, called *appendix vermiformis*, which is about the size of a goose-quill, and three or four inches in length: it communicates with the interior of the cœcum. The exterior of this intestine is marked by three longitudinal depressions, which commence from the point of attachment of the vermiform appendage; and other annular constrictions throw it into folds so as to give it a sacculated character: several small appendages of the peritoneum, containing fat, are also seen on its surface; they are the appendices epiploicæ. The muscular coat of the cœcum consists of longitudinal and annular fibres: the former are collected, as already noticed, into three bands, which, from their relative shortness, give rise to the sacculated character just alluded to. The mucous membrane is evenly disposed over the interior of the cœcum, but presents a remarkable reduplication at the point of entrance of the ileum: this, the ilio-cœcal valve, results from the folding of the mucous membrane of the small intestine which projects into the cœcum, and thus consists of two lips, which are so placed in relation to each other as to present a transverse fissure when the intestine is distended and dried: the extremities of these lips are connected by commissures. By the above arrangement regurgitation of the contents of the cœcum or colon is prevented.

The *Colon* is divided into four portions. The ascending division lies in the right lumbar region, in front of the quadratus lumborum muscle and right kidney, and more or less concealed by the folds of the small intestine: its superior extremity touches the under surface of the right lobe of the liver and gall-bladder. From the last-mentioned point the arch or transverse portion of the colon proceeds from right to left, crossing the epigastric region below the stomach and above the small intestines, and covered anteriorly by three of the four laminæ composing the great omentum: its termination is somewhat higher than its commencement, being placed in the left hypochondrium, and closely approximated to the spleen. The descending colon is a continuation of the same intestine through the left lumbar region to the iliac region of the same side, where the sygmoid flexure is attached: each of these divisions holds relations analogous to the corresponding portions of the opposite side. The connexions of the sygmoid flexure are sufficiently loose to allow it to expand more or less into the pelvis: it derives its name from the double turn it forms, and terminates just above the left sacro-iliac articulation in the rectum. Of the four divisions of the colon the arch is the most capacious, and the ascending division rather the smallest. The appendices epiploicæ are scattered over the different portions, and are especially numerous on the arch. Each division is to a certain extent confined in its position by its peritoneal investment: the sygmoid flexure is the most moveable. The muscular and mucous coats present a similar character and arrangement to that already described in the cœcum.

The *Rectum* extends from the termination of the colon to the anus, taking first an oblique course, and then descending in the median line. This intestine presents a curvature corresponding to that of the sacrum, against which it lies; but it subsequently bends forwards to obtain a position anterior to the coccyx before it dips down to terminate in the anus. The anterior relations of the rectum differ in the male and female; but in both a cul-de-sac of peritoneum is found immediately in front of the intestine above. Below, in the male, the rectum corresponds to the vesiculæ seminales, prostate gland, and lower fundus of the bladder; but in the female it is related to the posterior surface of the vagina: the upper fundus of the bladder in the male, and the uterus in the female, correspond to the superior anterior part of the rectum. As regards calibre, this portion of the great intestine is somewhat smaller than the colon, but is capable of considerable distension: a permanent dilatation exists near its inferior extremity. The rectum is fixed in its position by the meso-rectal fold of peritoneum. Its muscular coat is distinct and dense: the superficial fibres are longitudi-

nal, and especially developed in the two upper thirds; whereas the annular fibres which constitute the deeper layer are more developed near the anus. The levatores and sphincter ani also enclose the lower part of the gut. The mucous membrane presents no character, save that of increased vascularity, by which it can be distinguished from that of the colon.

A microscopical examination of the elementary muscular fibre of the membranous digestive viscera proves that both laminæ throughout consist exclusively of the unstriped fibres common to most of the involuntary muscles: the sphincter ani consists of striped fibres. The average length of the human intestinal canal may be stated at about thirty feet, of which the large intestine constitutes one-fifth.

The *Liver* is the largest of the glandular viscera connected with digestion. It is of a reddish brown colour, and occupies the right hypochondriac and upper part of the epigastric regions. Its extent, size, and form vary slightly in different individuals, independently of marked changes. The superior surface is convex, and corresponds to the diaphragm, which it presses upwards so as to encroach upon the right side of the thorax; the inferior surface is irregularly concave, and presents a horizontal fissure or groove which corresponds to the line of reflection of the suspensory ligament above: this lodges the remains of the umbilical vein, and divides the liver into two unequal lobes, the right and left. Extending from the horizontal fissure, transversely to the right, is the porta or transverse fissure, in which lie the hepatic vessels; and behind the porta is the third lobe, or lobulus Spigelii, which occupies a position between the vena cava and œsophagus, and is connected to the right lobe by two processes: one of these is thick, and placed transversely. The groove in which the vena cava is lodged is between the right and spigelian lobes; and in the same line, but anterior to the porta, is the depression for the gall-bladder: the under surface of the right lobe is further marked by shallow depressions, corresponding to the right kidney and right angle of the colon. The under surface of the left lobe is concave, and corresponds to the upper and anterior surface of the stomach. The posterior margin of the liver is thick, obtuse, and rounded, especially towards the right side, and presents a deep notch corresponding to the bodies of the vertebræ; the anterior is thin, and is marked by an abrupt notch opposite the horizontal fissure at which the umbilical vein becomes attached to the liver. The lateral edge of the right lobe is thick, but that of the left is gradually bevelled and thin. The *Gall-bladder* is in shape pyriform, and occupies the position already indicated, generally extending beyond the margin of the right lobe, which presents a broad and sometimes deep notch at the point in question. The upper surface of this membranous viscus is in close connexion with the texture of the liver, to which it is bound by a superficial covering of peritoneum: its narrowest portion or neck is directed backwards and towards the left side, and terminates gradually in the cystic duct, which joins the common hepatic duct at an acute angle to form the ductus communis choledochus. Independently of the serous covering already described, the liver has a proper investment of its own, which is of a condensed cellular nature, covering its whole surface, and reflected around the vessels at the porta, so as to pass with them (under the name of Glisson's capsule) into its interior. The interior of the gall-bladder consists of soft and thick mucous membrane, connected by cellular tissue to the serous envelope and liver. The vessels which enter the liver are the hepatic artery for its nourishment, and the vena portæ for the secretion of bile: the hepatic duct is formed by the junction of a branch from either lateral lobe, and also leaves the porta: the venæ cavæ hepaticæ return the venous blood to the vena cava ascendens.

The investigations of Mr. Kiernan* have clearly demonstrated the following facts in connexion with the minute anatomy of the liver: the subjoined is a brief abstract of his description. The liver presents three *surfaces*—the external (already considered); the portal, containing the vena portæ, hepatic artery, and hepatic duct; and the hepatic venous surface, containing the vena cavæ hepaticæ. The *substance* of the liver is made up of lobules, vessels, nerves, and cellular tissue. The lobules are based, like leaves without footstalks, on the hepatic veins; and the interspaces between them are named the interlobular fissures. Four sets of *vessels* ramify in the interior of the liver:—1. *Hepatic veins*, the larger branches of which are called hepatic venous trunks, and the smaller the sub-lobular branches, being those on which the lobules rest. From these last, perforating twigs are given off, which enter the lobules and are thence named intra-lobular: between these ultimate branches there is no communication. 2. *Hepatic artery*, ramifies on the vessels and other textures of the liver for their nourishment, and then terminates in the portal system, thus aiding indirectly in the secretion of bile. 3. *Vena portæ*, the destination of which is to the spaces and fissures between the lobules, where they give off branches which penetrate into the interior of the lobules, where they ramify towards the centre: the larger branches between the lobules are named inter-lobular veins, and those which circulate in the lobules are the lobular venous plexuses: these last meet and anastomose with the intra-lobular plexuses of the hepatic veins: the inter-lobular branches of the porta also communicate freely with each other. 4. *Hepatic duct*, the ramifications of which accompany the inter-lobular branches of the portal vein, to carry away the bile when secreted. Where the ultimate twigs of the two last-named vessels terminate, minute yellow points are perceptible: these are the acini of Malpighi. The cellular investment of the vessels, called *Glisson's capsule*, accompanies the vessels which enter the porta, and proceeds with them to their destination, so as even to form a capsule to the lobules. Either of the above sets of vessels may become congested separately, giving rise to different colours and to varying relative density; a fact which Mr. Kiernan notices as a prolific source of error in the descriptions of previous anatomists.

The *Pancreas* is an elongated conglomerate gland, of a greyish colour, and essentially the same in character and structure as the salivary glands. Its long axis is transverse, and it is stretched somewhat obliquely across the spine, about opposite the second lumbar vertebra, its right extremity being lower than the left. The length of the pancreas is about seven inches, but it varies in size and weight. Its anterior surface corresponds to the stomach, and it is covered by the ascending layer of the transverse meso-colon; poste-

* *Philos. Transact. for* 1833. Part 2.

riorly it is in contact with the left crus of the diaphragm, vena cava, and aorta. Its left extremity is small and approximated to the spleen; but the right is larger, is named the head, and lies in the curvature of the duodenum: the upper and back part of the gland is grooved to lodge the splenic artery and vein. Frequently a detached portion of the gland lies beneath the head, and is thence called smaller pancreas. The excretory duct is pale and thin, and placed somewhat nearer the posterior than the anterior aspect of the gland: it extends from left to right, increasing in size as it collects the radicle branches from the surrounding lobes, and emerges at the head to join the ductus communis choledochus at an acute angle. The two ducts terminate, as already noticed, either conjointly or near together, in the duodenum.

The *Spleen* is usually enumerated amongst the glands of the abdomen, though its title to this appellation seems more than questionable. It occupies the deepest part of the left hypochondrium, being connected to the great extremity of the stomach by the gastro-splenic omentum: its upper and outer surface is convex, and corresponds to the diaphragm; below, it overlaps the upper part of the left kidney and supra-renal capsule: internally, it is fissured for the transmission of the vessels; and posteriorly, it rests to the left of the spine. The colour of the spleen is purple, its texture spongy, and it is very vascular. It is supplied with a fibrous investment which sends processes into its interior. On minutely examining the structure of the Spleen, it is found to present spaces which are bounded by the reticulated substance of the organ; these are venous canals, which, when injected, appear similar in character to those of the corpora cavernosa penis: there are no true cells. The red pulpy substance consists of granules, about the size of blood corpuscles, but globular. Malpighi further discovered in this substance whitish globules visible to the naked eye: these are difficult to detect in the human spleen. This organ has no excretory duct.

Physiology of Digestion.

Convenience has determined that nourishment should be conveyed into the circulating system of both animals and vegetables in a fluid form; but for the most part solid food is the support of animal life, and hence the difference and contrast in the assimilating apparatus of the two divisions of the organic kingdom. Thus a complex provision is requisite for the reduction of animal food prior to its being absorbed by the lacteal vessels from the alimentary canal; whereas the roots of plants, which are the analogues of the lacteals in animals, directly absorb the prepared aliment from the matrix in which they are lodged. The further processes of circulation and aerification are similar in the two kingdoms, but at the same time present one remarkable and interesting contrast, which is all-important in the preservation of both animal and vegetable life, viz., the mutual interchange of gases in respiration, which operates both negatively and positively in effecting the desired end.

In tracing the progress of the food, and following the same course as that which has been pursued in the anatomical section, the mouth first presents itself for consideration. The *lips* exhibit varied forms and degrees of development, according to the functions required of them in different classes of animals: thus their greater mobility and relative development in some graminivorous animals is connected with their use in collecting their food,—a pecularity which is much exaggerated in some species, and arrives at its maximum in the elephant, in which animal the remarkable production of the upper lip (the proboscis), and its great power and flexibility, enable its possessor to select the herbage indiscriminately from the earth on which it treads, or from the trees of the forest which it frequents. In man, though the lips are serviceable in the acts of mastication, their peculiar organization and great mobility are rather associated with the more exalted office of the articulation of sound and production of language. The *Comminution* of the food is effected in various ways, according to the nature of the aliment and habits of different animals. Three modes of reducing solid food may be enumerated: trituration, as in man; laceration, as in birds of prey; and by the gizzard, as in the granivorous birds. In mammalia, the titles "carnivorous" and "graminivorous" are assigned to animals whose natural food is exclusively animal or vegetable; and each class is characterized by corresponding development of the organs of comminution. In the carnivora the *jaws* are massive and present a simple hinge arrangement, whilst provision for great lateral motion is made in the construction of the jaws in vegetable feeders; there is also a corresponding relative development in the prehensile and grinding muscles. The *teeth* also, as might be anticipated, present a remarkable contrast in animals whose habits are so different: thus, the compressed crowns and pointed processes of the grinders, the lower closing within the upper, are peculiarly fitted for the office of lacerating flesh; whilst, on the other hand, the expanded, oblique, and permanently uneven surface of the corresponding teeth in the graminivora (especially the ruminants) are equally adapted for the grinding of vegetable matter: indeed, the analogy of the scissors and mill-stone, as applied to the forms of mechanism above alluded to, is not inapt. The mixed development of both the jaws and muscles, and of the teeth, in man, point him out as partaking of the characters of both classes of animals above alluded to: his moderate incisors and small canines, his expanded molars, and the lateral motion of the lower jaw, indicate that he is omnivorous, or destined to be nourished by a mixed animal and vegetable aliment. The integrity of the teeth is essential to the prolonged existence of animals, and usually determines that existence when its period has not been curtailed by some of the countless risks to which all creatures living in a state of nature are subjected: thus, when deprived of teeth, the graminivorous animal starves, and the predacious in turn falls a prey to others.*

The uses of the *cheeks* and *tongue*, as connected with mastication, have already been cursorily alluded to: by these organs the food is pressed on either side, so as to keep it between the teeth during the act of trituration: the tongue further conveys the food into the pharynx. Before leaving the mouth the bolus has to be moistened by the various secretions of the *buccal*, *salivary*, and *tonsil* glands. The mucous membrane of

* For further details on the development of the teeth in different animals, the reader is referred to the 'Comparative Anatomy of the Osseous System.'

the cheeks, lips, and tongue are supplied liberally with secreting follicles, which give out their secretion during the act of trituration. Further, the position of the salivary glands is such as to subject them to the action of the muscles of mastication, by which means they are mechanically stimulated to pour forth saliva, as occasion requires, in increased abundance: dry food, acids, &c., also excite a flow of this secretion, which likewise appears, in common with some other secretions, to be considerably influenced by mental emotions: thus the remembrance of agreeable food is proverbially said to "make the mouth water;" and the parched mouth, from suspension of this secretion, is no less characteristic of deep grief or paralyzing terror. The burning thirst of fever and impairment of the sense of taste also seem to be principally referable to the suppression of the salivary secretion. The saliva, according to Berzelius, contains about one per cent. of solid ingredients: the following is his analysis:

Water	992·9
Peculiar animal matter	2·9
Mucus	1·4
Alkaline muriates	1·7
Lactate of soda and animal matter	0·9
Pure soda	0·2
	1000·0

When duly moistened, the bolus of food is placed on the surface of the tongue near to its base, and by it pressed backwards between the pillars of the fauces (where it is further lubricated by the tonsillitic secretion) into the expanded pharynx; this act, however, requires further consideration. *Deglutition* is partly effected by voluntary muscles, and in part by muscular contraction, altogether independent of the will; indeed, the various stages which compose the act, with the exception of the backward pressure of the tongue, are so far under the control of the excito-motory system, that without the necessary stimulus of the presence of food the effort cannot be completed. The true agency of the soft palate and its muscles has but recently been explained by Dzondi, in his dissertation on the subject.* Previous to this writer's description it was generally assumed by physiologists that food was prevented from entering the posterior nares by the soft palate being thrown back and raised; but Dzondi has clearly shown that when the food is placed within the grasp of the palato-glossi muscles, they, in their turn, contract and force the bolus onwards into the pharynx; but, simultanously with this second act, the glottis and epiglottis are approximated to each other by the twofold operation of the retro-pressure of the tongue and uplifting of the larynx, by which means, and the closure of the rima glottidis, the air-tube is effectually protected; and also the palate is fixed by the action of its tensor muscles, so as to enable the palato-pharyngei muscles to contract and close the isthmus of the fauces by the approximation of the sides of the posterior palatine arch; and the angular interval which is left above is occupied by the uvula. The self-same act by which the communication with the posterior nares is shut off aids in raising the pharynx to receive the food. The remainder of the act of deglutition consists in the alternate contraction of the pharyngeal muscles, and the peristaltic or undulatory contraction of the œsophagus, by which their contents are forced onwards to the stomach. That this the last stage of swallowing is essentially a muscular act, is illustrated by the mode in which a horse drinks, the fluid rising to the stomach against gravity. In pursuing the changes which the food undergoes in the stomach and alimentary canal prior to entering the circulating system, it will be inconsistent with the limits of the present article to encumber the subject of human digestion with illustrations drawn from a comparison of the structure and functions of the assimilating apparatus in various classes of animals with those of man; suffice it to observe that the modifications, in development and office, go hand in hand; that where the food possesses qualities which are remote from those of the matter into which they are to be ultimately converted, and the loss of which they are to supply in the animal frame, the organs of digestion are correspondingly complex; but that where identity in the properties of the aliment and the frame to be nourished exists, they are comparatively simple. A comparison between the membranous chylopoietic viscera of flesh and vegetable feeders affords an ample illustration of the above assertion.

The *Stomach* in Man is principally a secreting organ; but it also aids in the digestive process by its muscular contractions. It has been observed that the stomach presents two orifices,—the Cardiac or œsophageal, and the Pyloric or intestinal; each of these is guarded by a muscular ring,—that of the former being the circular œsophageal fibres and the fleshy opening in the diaphragm, and that of the latter the annular fibres of the pylorus: this arrangement is essential to prevent the escape of food from the stomach during the act of digestion. The size of the cardiac orifice varies much in different animals: in the dog it is large, and readily admits of the regurgitation of the food; whereas it is contracted in the horse. In ruminant animals, the facility with which the food is returned to the mouth is greatly aided by the muscular development of the œsophagus. In connexion with the present division of the subject, it will be requisite to insert a few observations in relation to the act of vomiting. The question whether the stomach takes any active part in rejecting its contents has been often discussed, and been made the subject of experiment, with varied results. There is but little doubt in the writer's mind that, though the parietal compression is generally the most efficient agent, the antiperistaltic action of the stomach and œsophagus always co-operates, and may, even unaided, reject the food. The following appear to be the different preliminaries and conditions which constitute the act of vomiting. A deep inspiration is taken, by which the chest is distended and the diaphragm pressed against the abdominal viscera; the glottis is then closed to preserve the above condition; the abdominal muscles are now called into action, and the stomach compressed between them and the fixed diaphragm, so as to be forced to part with its contents. In this last stage of the act there is no interference on the part of the muscular opening in the diaphragm; for the active contraction of that muscle is superseded by the closure of the glottis, and consequent passive distension of the thorax. Here also the important office fulfilled by the muscular ring of the diaphragm in relation to the stomach may be indicated, viz., the protection it affords

* *Ueber die Functionen des Weichen Gaumens.* Halle, 1831.

Anatomy. to this viscus when distended during the acts of inspiration; the contraction of the fibres around the œsophagus concurring with the action of the whole muscle, and thus presenting an obstacle to regurgitation, where the stomach is most subjected to compression by the descent of the diaphragm. The muscular movements of the stomach appear to be under the control of the sympathetic system.

In the Stomach the food has to be subjected to the action of the gastric juice; and the peristaltic movements of the viscus subserve the purpose of bringing different portions of its contents into contact with its surface, and therefore under the more direct agency of the solvent fluid. The qualities and even the existence of the gastric juice was, for a long period, a subject of controversy with physiologists; and it is chiefly to the comparatively recent experiments of Dr. Beaumont, which a happy chance enabled him to make, that we are indebted for our present definite information upon the subject. The observations alluded to are valuable and interesting, being the result of direct experiment upon an individual named St. Martin, in whom a fistulous opening below the left mamma, and communicating with the stomach, remained after a gun-shot wound.* The difficulty of ascertaining the essential constituents of the gastric secretion depends on the obstacles offered to obtaining it in a pure and unmixed state, owing to its suppression during the intervals between the periods of digestion. The most apparent properties appear to be the following:—1. It is decidedly acid; for the digested food taken from the stomach is found to yield acids which are not the product of fermentation: 2. It does not promote putrefaction, but on the contrary possesses antiseptic properties, as proved by repeated experiments. It may be further remarked, that the solvent quality of this secretion bears an inverse proportion to the muscular strength of the stomach. The conflicting opinions which were maintained regarding the acid qualities of the gastric juice appear to have had their origin in the difference of period selected for the examination of this fluid; and it is to the accurate researches of Tiedemann and Gmelin that we were first indebted for a clear exposition of the sources of fallacy. The results of their experiments establish the fact, that both in vegetable and animal feeders (horse and dog) the gastric secretion was nearly neutral when the stomach was void; but that decidedly acid qualities were developed as soon as food was introduced, or even mechanical irritation employed. Dr. Beaumont's observations enable him to state, that in his patient the gastric juice was poured out over the surface of the stomach at various points, which appear to be simple follicles of the mucous membrane. He describes it as a transparent fluid, devoid of odour, slightly saline, and very perceptibly acid: and when subjected to analysis from the same source, it was found to contain free muriatic acid, acetic acid, phosphate and muriate of potash, soda, lime, and magnesia, and an animal matter soluble in cold water. That the solvent power of the stomach resides in the gastric juice, has been amply verified by the experiments of the same observer, who obtained from the source already mentioned, by mechanical irritation of the stomach, sufficient of the fluid to enable him to watch the process of digestion. The general result of these experiments was, that the fluid thus obtained was capable of completing digestion out of the body as perfectly, although more tardily, as in the natural way: it was necessary to preserve a temperature approaching 100° Fahrenheit, to ensure the success of the experiment: for when the fluid was permitted to cool, digestion was almost or entirely suspended. Satisfactory as the above results may appear, and easy as would seem to be the transition to purely artificial digestion, still experimenters failed in producing solution of animal matter by any artificially prepared fluid. The cause of this failure and the compound character of the solvent have been clearly demonstrated by the discoveries of Eberle, to which those of Schwann and Müller may be added. The first of these physiologists showed, in a paper which he published on the subject,* that the true solvent consists of an admixture of acid with mucus, although either separately is inert. He further asserted, that mucus procured from any other source was equally efficient with that obtained from the stomach; but this has been denied by Schwann and Müller, who found that no such substitute for the gastric mucus was admissible. The experiment, as detailed by Müller, is very easily performed by placing in a test-tube or any convenient vessel some small pieces of dried mucous membrane of the stomach, in an admixture of an ounce of distilled water, with a few drops of muriatic or acetic acid: to these a piece of hard-boiled white of egg is to be added, and a temperature of about 100° Fahrenheit maintained: in the course of twenty-four hours the solution of the albumen is usually complete. Further, the experiments of Schwann prove what might have been anticipated,—that an infusion of mucuous membrane with dilute acid, when filtered so as to be deprived of all solid particles, still possesses its solvent property. The preceding remarks are not found equally applicable to all articles of food; for whilst animal fibre and coagulated albumen are soluble in this compound fluid, which Schwann calls *pepsin*, he states that gelatin, casein, and vegetable gluten are not so, but are dissolved principally by the acids.† Various experiments have been instituted to prove the influence of the nervous system in digestion; and the most trustworthy of them seem to indicate that the pneumogastric nerves are importantly associated with the secretion of the digestive fluid. The division of this pair, which was followed by death at different intervals, appeared to suspend entirely, or almost so, the solution of the food. These results, however, have not been obtained by other physiologists; and it must be acknowledged that the present appears to be an exception to the prevailing relation between the sympathetic system of nerves and secretion; and one can scarcely wonder that such a mutilation as that above described should be succeeded by impaired or even suspended digestion, where death is inevitably entailed, in quadrupeds after a few hours, and in birds after the lapse of a few days at furthest. The experiments of Dr. W. Philip, which he considered to prove that the arrested function was restored by a current of electricity directed through the divided nerves to the stomach, have not succeeded in the hands of others.

* *Experiments and Observations on the Gastric Juice, &c.* By W. Beaumont. Boston, 1834.

* *Physiologie der Verdauung.* 1834.

† For further particulars the reader may consult Müller's *Physiologie*, p. 517, &c.; or Schwann's original papers in Müller's *Archiv.* for 1836.

The whole contents of the stomach are not submitted at once and simultaneously to the agency of the gastric fluid, but the process is aided in the following way by muscular action, according to the observations of Magendie. When a meal has been taken, the stomach is closely applied around its contents, and the periodical peristaltic motions are usually observed to commence a little beyond the pylorus, and to extend across it to the large extremity: an interval then occurs, which is succeeded by contraction, extending through the pyloric half of the stomach towards the duodenum, such portions of the contents as are prepared being transmitted by the pylorus into the intestine. A succession of these motions is repeated several times, and then a longer interval of rest succeeds: and it appears that the splenic extremity of the organ takes but little, if any, part in these undulatory movements until the greater part of the contents are digested and got rid of. We may infer, from these observations of M. Magendie (which have been confirmed by Beaumont and others), that a circular motion is given to the food along the two curvatures of the stomach, by which different layers are submitted in succession to the continually secreted gastric juice, until all is dissolved, or converted into *Chyme*, which is permitted to pass into the duodenum by the relaxed pylorus: in the earlier periods of digestion, the contraction of the annular muscle at this part of the stomach is such as even to arrest the transmission of liquids. It is the opinion of M. Magendie that fluids are directly absorbed from the stomach: but observation has proved that in some animals, as the horse, water rapidly finds its way even to the cœcum. It may be here remarked, that dilution of the gastric juice materially curtails, or, if copious, even destroys, its solvent property; a circumstance which should be particularly impressed by the practitioner of medicine on his dyspeptic patient, and which no one should be ignorant of. Some interesting tables of the relative digestibility of different kinds of food are given by Dr. Beaumont in his paper already quoted: the general result proves that in man animal substances are more quickly digested than vegetables. It may be also inferred, from the observations made above, that articles of diet which are not readily permeable by the gastric fluid (such as new bread or hard dumplings), must, from this mechanical obstruction, be more difficult of digestion than those which are more readily saturated. The observations of Marcet, Prout, and others, show that the constituents of the chyme vary according to the nature of the food: the principal are albumen, a substance resembling casein, and osmazome, mingled with the various secretions which have been enumerated. It may be further remarked, that in dogs the chyme contains more albumen when the diet consists of animal substances.

The next stage of digestion takes place in the duodenum, and consists of the conversion of the chyme into chyle: and this will involve some preliminary notice of the functions of the liver, pancreas, and spleen. The importance of the *Liver*, as subservient to digestion, is attested by the almost universal presence of this organ, even amongst the lowest animals. It is of large size in amphibia and in domestic animals; and does not uniformly present the even exterior which exists in man, but it is deeply grooved in some of the carnivora, as the lion,—a character which has been supposed to be connected with the violent and distorted movements of the body in these animals. The researches of Mr. Kiernan confirm the opinion which has been generally entertained, that the biliary secretion takes place from the capillary terminations of the vena portæ. It is true that the secretion has not been wholly arrested by ligature of the vena portæ; but this objection is met by the anatomical fact clearly established by Mr. Kiernan, that the hepatic artery ultimately pours its blood into the portal system: and even where the vena portæ has been known to terminate in the ascending cava, of which there are cases recorded by Mr. Abernethy and Mr. Lawrence, it seems probable that the internal arrangement of the blood-vessels involved the conversion of the arterial into venous blood before the separation of the bile took place. The several functions of the vessels which circulate blood in the liver may be thus stated: the hepatic artery is the nutrient vessel; the vena portæ the secreting vessel; and the venæ hepaticæ are the returning vessels of the blood. The bile, as already stated, is conveyed to the duodenum by the biliary ducts. The physical properties of the *Bile* are, that it is of a yellowish-green colour, bitter in taste, and of a faint disagreeable smell. Its re-action is decidedly alkaline; and it is much more viscid and deeper in colour after remaining for some time in the *gall-bladder;* a condition which appears to depend on the absorption of its more fluid part. This membranous viscus is not an invariable appendage of the liver, but is present, according to Cuvier, in those animals which take their food at long intervals and in large quantities, as the carnivora; whilst those of the horse and goat kind want it: the ruminantia possess it. It has been observed, that the quantity of bile contained in the gall-bladder varies, being considerably more abundant prior to digestion than subsequent to its completion. We may therefore infer that this viscus has the twofold function of acting as a reservoir and filterer of the bile. The various analyses which have been made of the bile do not present very consistent results, which Berzelius attributes to the tendency to decomposition which he considers certain simple substances it contains to have: that which Gmelin and Thenard describe under the titles of picromel and biliary resin, Berzelius calls biliary matter. According to Müller, the bile contains grey particles, which in the frog he found five times smaller than the red corpuscles of the blood.* The following is the analysis of ox bile, as given by Berzelius in his *Animal Chemistry.*

Water	90·44
Biliary matter, with fat . . .	8.00
Mucus (from gall-bladder) . .	·30
Osmazome—chloride of sodium, and lactate of soda. . . .	·74
Soda	·41
Phosphate of soda and of lime, with a substance insoluble in alcohol	·11
	100·00

The *Pancreas* is by no means so universal an organ as the liver, being confined almost exclusively to the vertebrate class, and not present in many fishes. Moreover, experiment has proved that it is not essential to

* Müller's *Physiologie*, vol. i., p. 502.

digestion, as the gland has been removed in animals without producing any marked effect. The position of the Pancreas renders it difficult to obtain the secretion; but this has been done by Tiedemann and Gmelin, who collected the fluid by the insertion of a tube into the duct. Their account of it is, that it is clear and ropy, slightly saline to the taste, and containing albumen in considerable quantity: also some osmazome, and a substance like casein; and free acid (probably acetic) in very small quantity; the great bulk of the secretion being water. Other experimenters mention having met with the salts of soda, potash, and lime in it: it differs further from the saliva in containing no sulpho-cyanic acid.

The *Spleen* is almost universal amongst vertebrata, and confined to them. Its structure and organization have been already described. The hypotheses which have been broached respecting the function of this viscus have been numerous, and many of them as ill-founded as the premises and experiments which led to the conclusions were erroneous and ill conducted. Its proximity to the stomach have naturally induced physiologists to associate it in function with that organ: hence it has been supposed to act the part of a reservoir for the blood when the stomach was empty; and that the replete condition of the latter forced the blood from the spleen by compression. An eminent physiologist recently taught that it acted as a reservoir under violent exertion, and stated that the bile underwent no chemical change after its removal. These mechanical uses, and the absurd impression that it operates as a counterpoise to the liver, are probably quite insufficient explanations of its real use: and although some part may be assigned to it in the preparation of the venous blood for the secretion of bile, one would more readily coincide with Müller, who supposes that the spleen is connected with sanguification, and influences the blood which passes through it in some way which is not at present understood: this physiologist further thinks it may be employed in the secretion of a peculiar lymph; as Hewson supposed it formed the vesicular portion of the blood corpuscles.

In order to test the influence of the bile in digestion, experiments were instituted a long while since by Brodie, the results of which have been confirmed in many particulars by those of Tiedemann and Gmelin. Obliteration of the ductus choledochus was invariably followed by jaundice, which continued until the death of the animal, which usually occurred at the expiration of two or three weeks: in a few instances recovery followed the re-establishment of the obliterated canal. The process of digestion in the stomach, that is, the production of chyme, was in no way interfered with: but according to Brodie, the further change into chyle did not take place. The experiments of Tiedemann and Gmelin led them to an opposite conclusion in this last important particular, and they believe the bile to be a solvent of fat by combining with it mechanically. A simple experiment, the correctness of which may be tested by any one, would seem to corroborate the justness of the former view. If a rabbit be killed about an hour after it has been fed, and the contents of the stomach emptied into a piece of muslin, a limpid fluid may be expressed, which, when mixed with bile from the same animal, forms a milky compound which has all the physical characters of chyle. The experiments of Dr. Beaumont also confirm this view. The following, therefore, appear to be the offices of the bile:—1. It is an excretion by which noxious or useless substances are disposed of, viz.:—the colouring matter and resinous portion; 2, by it the chyme is converted into chyle, or, as Prout supposes, albumen is produced from the food; 3, it appears to act the part of a stimulant to the peristaltic motion of the bowels, as obstruction of the gall-ducts is accompanied by constipation, and the sudden removal of the impediment, by diarrhœa. That the bile sometimes finds its way into the stomach, is clearly proved by its being vomited. This fact, taken in conjunction with that above alluded to, regarding the arrest of artificial digestion by the addition of bile, may account for many of the phenomena connected with indigestion, and its attendant symptoms. The flow of the bile and pancreatic secretion is probably occasioned principally by a stimulus propagated from the duodenum along the ducts: indeed, recent investigations seem to render it probable that at least the ductus choledocus possesses a covering of muscular fibres belonging to the unstriped variety.* The contiguity of the duodenum and gall-bladder may likewise aid in the evacuation of the latter, when the former is distended.

In the small intestines, both the chyme and chyle are modified according to the nature of the food: thus, gelatin, when taken, may be detected; so likewise casein, when cheese is eaten, and starch after oats, or cheesey clots after milk; but albumen and casein, especially the former, are most generally and abundantly present. The office of absorbing the chyle, or nutritious portion of the food prepared for circulation, is not confined to the absorbent vessels of the small intestines, though it is principally performed by them: but that the large intestines have a share in this process, is proved by authentic instances of individuals being nourished for a lengthened period exclusively by injections of nutritious matter per anum,—a proceeding successfully resorted to where the powers of life are ebbing, and the stomach is incapable of receiving, digesting, or passing onwards its contents, as in scirrhus of the pylorus, stricture of the œsophagus, &c.

The vessels by which the Chyle is absorbed from the intestine are named *Lacteals*. They take their course between the layers of the mesentery, and terminate in the thoracic duct; passing, in their progress, through the mesenteric glands, where some further modification of their contents, which is not fully understood, takes place. The mode by which the lacteals absorb the chyle is involved in considerable mystery. Dutrochet conceived that in animals as well as plants the process of absorption was due to the law of endosmose. To capillary attraction also the property has been attributed; but be this as it may, it is clear that the lacteals must communicate by open mouths with the surface of the intestine. It has been justly remarked by Müller,† that the intestinal villi cannot under any circumstances be the only organs of absorption, as they do not exist in all animals; but he seems to assign this office to the orifices of Lieberkuehn's follicles. When chyle is obtained from the thoracic duct, it is found to differ from lymph (which is limpid) in presenting a white milky appearance. The microscope demonstrates the existence of globules, about one-half or one-third the size

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* See Todd's and Bowman's *Physiology*, p. 162.

† *Physiologie des Menschen*, vol. i., p. 254.

of blood corpuscles. Like the blood, the chyle coagulates spontaneously, on exposure to the air, in about ten minutes, separating into a solid portion and serum; at least such is the case with that taken from the thoracic duct, though Tiedemann and Gmelin believe that this property is not acquired until after the chyle has passed the mesenteric glands, when it is also observed to assume a red tinge: it would, therefore, seem probable, that in these bodies some elaboration of the fluid takes place by which it becomes more assimilated to the blood. The coagulum of the chyle is, as in the blood, the fibrinous portion mixed with globules; and Müller states that the serum is a solution of albumen mixed likewise with globules, on the surface of which fatty particles collect. The following are the most striking points of difference, noticed by this physiologist, between the chyle and blood:*—1. The globules of the former are insoluble in water, whereas the blood corpuscles are so soluble, even to their nuclei. 2. The absence, in chyle, of the red colouring matter of the blood (not constant). 3. The form and size of the globules differ. 4. The alkaline re-action of the blood is greater. 5. The chyle contains less solid matter than the blood; and the proportion of fibrin is remarkably contrasted in the two, being far more abundant in the blood. 6. The chyle contains fat in a free state, whilst that of the blood exists exclusively in combination with other matters. 7. Both contain iron, which is more easily extracted, by the action of reagents, from the chyle. There are also other points of difference, but of less importance. The experiment of placing a ligature on the thoracic duct generally proves fatal in a period varying from a week to a fortnight, and results apparently from simple inanition. Where death does not ensue, it may be presumed that there are two ducts, or that some other abnormal arrangement exists.

The mucous membrane of the intestines has been described as a secreting surface; and doubtless this secretion is of importance in the process of assimilation. This is probably more especially the case as regards the cœcum, which is particularly large in herbivorous animals, although the peculiar function of this enlarged portion of the alimentary canal is not understood. The mucous fluid in the upper part of the small intestines is usually found to contain some free acid, with albumen, biliary matter, the usual salts of animal fluids, and some other unimportant and accidental substances. These conditions, however, vary in different animals: in the cœcum of herbivora, Schultz found a decidedly acid re-action: but in carnivora, where the cœcum is much less developed, this was usually not the case. Thus, the ingesta, in their progress through the alimentary canal, become separated into the nutritious and excrementitious portions; and as the absorption of the former or more fluid part continues during the onward passage of the mass, the latter gradually assumes a more and more consistent character. The motion of the intestines, by which their contents are carried forward, is vermicular or peristaltic, the course of the undulations or waves being directed towards the anus. This motion may be readily excited in a recently-killed animal by mechanical stimulants, electricity, or even by simple exposure to the air: it would, moreover, appear to be under the control of the sympathetic system of nerves, as complete isolation from cerebro-spinal influence, by removal of the viscera, does not arrest or alter the normal character of the intestinal movement. The Sphincter ani unquestionably possesses a tonic contractile power, to which volition occasionally lends its aid.* The great bulk of the solid portion of the fæces is found to consist of the indigestible and unnutritious parts of the food, and therefore varies according to the nature of the aliment taken, the colour being due to the bile. The following analysis of human fæces is given by Berzelius, in his *Animal Chemistry*, p. 268:—

Water			75·3
Soluble in water.	Bile	0·9	5·7
	Albumen	0·9	
	Peculiar extractive matter	2·7	
	Salts	1·2	
Insoluble residue of the food			7·0
Insoluble matters superadded in the intestine—mucus, biliary resin, fat, peculiar animal matter			14·0
			102·0

The gas which is found in the alimentary canal seems to be derived from several sources, and varies in character according to its position: it is swallowed with the food; generated by decomposition; and may possibly be secreted. The gases usually met with are, carbonic acid, hydrogen, and nitrogen; and, in addition to these, carburetted and sulphuretted hydrogen in the large intestines.

It has been stated that the nutritious part of the food is conveyed, in the form of chyle, along the lacteals to the *Thoracic duct*, which commences by a distinct dilatation, named *Receptaculum chyli*, the position of which is between the aorta and body of the second lumbar vertebra. From this point the duct ascends into the posterior mediastinum, through the aortic opening in the diaphragm, and between the aorta and vena azygos. About opposite the sixth dorsal vertebra it bends towards the left side, and then ascends behind the arch of the aorta, to occupy the interval between the left subclavian and carotid arteries. Opposite the last cervical vertebra it hooks downwards and inwards behind the left inferior thyroid artery and internal jugular vein, and opens into the posterior part of the left subclavian vein, close to its junction with the jugular, to form the vena innominata. Regurgitation from the vein is prevented by a double valve which guards the aperture. The chyle is thus conveyed to the right side of the heart, whence it passes through the lungs, before it forms a part of the general circulating fluid.†

Before closing the present section, it will be necessary to make a few remarks on *Hunger* and *Thirst*. Many vague and ill-founded theories have been advanced to account for these sensations. One hypothesis gained considerable credit, which attributed hunger to the action of the gastric juice upon the mucous membrane of the empty stomach; but the fact that mental emotions destroy the appetite discountenances this suppo-

* *Op. Cit.*, vol. i., p. 548.

* This subject is further discussed under the head 'Nervous System.'

† For particulars respecting the structure of the Lacteals, see 'Lymphatic System.'

sition; in addition to which, it is ascertained that the digesting fluid is not generally secreted, except scantily, until it is needed.* It is most probable that hunger is a specific sensation referable to the nerves of the stomach; and experiment would seem to indicate the pneumogastrics as its special seat, for it is said that with their division appetite ceases. Thirst again is referred to the mouth and fauces; and no doubt these parts partake of the susceptibility to a sensation which is in reality common to the whole mucous membrane of the gullet and stomach; but it has been proved experimentally, that moistening the mouth, fauces, and pharynx, without supplying the stomach, are insufficient alone to allay thirst. When food is withheld, a sense of faintness takes the place of hunger. All the functions of the body are performed slowly and imperfectly; the secretions gradually diminish, and at length cease; and every part of the frame which the system can feed upon is taken up by the absorbents. Thus, emaciation goes hand in hand with increasing debility; and the passions are variously affected,—despondency, rage, delirium, alternating. Experiments (even the allusion to which is loathsome) prove that warm-blooded animals are least capable of resisting the effects of want of food. Man usually sinks soon, though there are some remarkable instances in which life has not become extinct for a fortnight or three weeks. The tormenting pangs of hunger soon yield to the intensity of the suffering occasioned by the want of drink, as attested by the painfully interesting accounts we receive from time to time of shipwrecked mariners. Water alone will protract life for a considerable period.

* It is not improbable that the well-authenticated instances which have occurred, of the stomach itself being found partially digested after death, may have lent their countenance to the theory alluded to. But the fact is, that living structures wholly resist the solvent power of the gastric juice, and therefore the stomach cannot have been thus acted on until after death.

ANATOMY.

SECTION VI.

ORGANS OF CIRCULATION.

The *Thorax*, or *Chest*, occupies an intervening position between the head and neck above and the abdomen below. It contains the organs of respiration and the fountain-head of circulation; and presents several remarkable points of contrast with the containing cavity of the digestive viscera, by which it is better adapted for the fulfilment of its peculiar offices. The properties of resistance, distensibility, and elasticity are here combined, by which protection to the important organs it contains, and a ready performance of their several functions, are admirably provided for. The form of the chest, whilst still clothed with the soft parts, and with the arms attached, conveys to the mind the idea of an inverted cone, which, however, is deceptive; for, when stripped of the above parts, the base of this imperfect cone is seen to be below, and its narrow part, or truncated apex, above. The sternum and costal cartilages form the anterior boundaries of the thoracic cavity; the dorsal division of the vertebral column, and the ribs, as far as their angles, bound it posteriorly; whilst the intervening portion of the ribs (between their angles and cartilages) and the intercostal muscles are its lateral boundaries: below, the diaphragm forms the septum between the chest and belly; and the superior narrow outlet is occupied by the trachea and œsophagus, with muscles, vessels, and nerves. When the skeleton of the chest is viewed in front, its anterior wall is observed to extend obliquely downwards and forwards, and to present a deep notch below, which is bounded laterally by the costal cartilages: the ensiform cartilage projects downwards from the lower extremity of the sternum into the centre of this notch. From this arrangement it results that the vertical diameter of the thorax is greater behind than in front, and that the axes of the outlets do not correspond. The mobility of the walls of the chest is essential to the respiratory acts, and is provided for by the nature of the articulations between the heads and tubercles of the ribs with the vertebræ on the one hand, and on the other by the long elastic cartilages, and their mode of union to the sternum and to one another.*

The Heart is placed in the centre of the chest, between the two lungs,—being attached at its base by the great vessels which carry the blood to and from it to the surrounding parts, whilst its apex is free and points towards the left side. This important viscus is loosely surrounded by a dense fibrous capsule or bag, which is lined by serous membrane: to this attention will be first directed. The *Pericardium*, as this bag is named, is closely adherent to the great vessels at the base of the heart, and also presents a broad, extended, and intimate attachment to the great central tendon of the diaphragm. In consequence of this arrangement, the narrowest or most contracted part of the pericardium corresponds to the base of the heart; and the converse is of course likewise the case. Anteriorly and posteriorly this membrane bounds the corresponding mediastinum; laterally the pleuræ separate it from the lungs; and on the great vessels which it surrounds it is found gradually to lose its fibrous character, becoming continuous with the condensed cellular tissue in the neighbourhood: sometimes a deep layer of the cervical fascia may be traced downwards on the vessels of the neck until it becomes identified with the fibrous pericardium. The serous membrane is to be examined by opening the bag: it is then found to consist of an investing and reflected layer; the former closely surrounding the structure of the heart, and the latter lining the fibrous membrane just described. The points of reflection by which these two layers are rendered continuous are the great vessels proceeding to and from the heart. The serous investment of the aorta is the most extensive; that of the vena cava corresponds to the point of entrance to the vena azygos; and that of the pulmonary artery is limited to the main trunk. Both right and left pulmonary veins are likewise invested by this membrane as they approach the heart; as also the very small portion of the inferior vena cava that is seen within the pericardium. All these vessels are thus surrounded by serous membrane, except at such points as they are in contact with each other. The functions of this important sac are very apparent: for not only does the double serous layer, with its smooth and lubricated surface, permit the free motion of the heart, but the dense fibrous exterior also protects this viscus from external pressure. The pressure here alluded to is that of the distensible viscera on either side of the chest; and the provision to arrest the encroachment of the lungs affords an interesting illustration of the simplicity and perfection of the mechanism, combined with economy of the means. It is during the act of inspiration that the heart's action is most liable to interference from the inflation of the lungs; but this act is effected by the descent of the diaphragm, and with this muscle the broad base of the pericardium is also drawn down; and thus there is even increased space for the play of the unattached portion of the heart, at the same time that the lateral walls of the bag are made tense, and the too close embrace of the lungs is averted.

The *Heart* is a muscular sac, of an irregularly conical form, consisting of right and left divisions, each of which is subdivided into two chambers, severally called auricle and ventricle. The *exterior* of the heart presents for observation its base, which is directed up-

* For further particulars the reader is referred to the 'Bones and Ligaments of the Chest,' in the section 'Osseous System.'

wards, backwards, and to the right side, and its apex, which points in the opposite direction, corresponding to the fifth intercostal space of the left side. The superior surface is convex, whilst the inferior is flat and triangular in form, and rests upon the diaphragm. The anterior margin is thin, and inclines downwards and to the right side; and the posterior or obtuse margin looks upwards and to the left side, corresponding to a depression in the left lung. Of the two sides of the heart, the right belongs to the pulmonary circulation, whilst the left is the systemic. Further, the auricles are the receptacles, and the ventricles are the propellers, of the blood.

The *interior* of the Heart presents, therefore, four cavities for observation, which communicate directly, or through the medium of vessels, with each other. They will be described in the order in which the blood circulates through them. The *right Auricle* partly rests on the diaphragm, and consists of a posterior dilated portion called the sinus, and an anterior loose portion called the appendix. The interior of this cavity presents the openings of the two venæ cavæ, which are situated at the back part of the sinus, and are separated by a very slight prominence, called the tubercle of Lower. The left wall of the auricle is almost exclusively membranous, and constitutes the septum auricularum: in this is a depression (fossa ovalis) circumscribed by a thick margin (annulus), marking the original communication between the auricles during fœtal life. In the anterior wall is the contracted circular orifice of the appendix: the interior of this division of the auricle presents muscular bands, called musculi pectinati. Anterior to the orifice of the inferior cava the semilunar Eustachian valve is seen: this partly surrounds the above opening, and is likewise connected to the left limbus of the fossa ovalis, which latter is separated by it from the orifice of the coronary vein. The orifice of the last-named vessel is between the Eustachian valve and the ventricle; and it is protected by a crescentic reduplication of the lining membrane, named the smaller Eustachian valve. The openings of other small veins are likewise seen on the interior of this cavity. Lastly, in the anterior and inferior part of the auricle is seen the auriculo-ventricular communication, which is circular, and marked by a well-defined, elevated, and whitish line. The *right Ventricle* is a a hollow cone, with its base towards the auricle, and its apex directed towards, though not extending as far as, the apex of the Heart. The two Ventricles are separated by a thick muscular septum, which encroaches upon the right cavity, and evidently belongs to and more especially influences the left Ventricle. Not only is the structure of the ventricular parietes essentially muscular, but their internal surface is rendered irregular by fleshy bands or columns, some of which are attached through their whole extent; others are free in the centre; and a third set, which are the most massive, are connected by broad fleshy attachments towards the apex of the Ventricle, and give off from their extremities small round tendons (chordæ tendineæ) which are inserted into the auriculo-ventricular valves. The base of the Ventricle presents two openings, the auricular and arterial: the former of these is posterior and to the right side of the latter, and is circular when distended, but elliptical when at rest. To the margin of this opening is attached the broad reflection of the lining membrane, which, from its threefold division, is named the tricuspid valve: to each of these folds the tendinous chords above noticed are attached; the left division is the largest, and is interposed between the auricular and arterial openings. The contracted orifice of the *Pulmonary artery* occupies the highest part of the ventricle, and is anterior and to the left side of the auricular opening. This vessel is connected to the heart by means of the external serous and lining membranes, between which the proper arterial coat is disposed in a triple crescentic border, which is attached to the muscular structure of the Ventricle; corresponding to this border the lining membrane is thrown into three folds, which are named the semilunar valves, and present their convex attached margin towards the heart, whilst the floating edge is free and projects into the artery, presenting in the centre of each a little cartilaginous body named corpus sesamoideum. From this origin the pulmonary artery proceeds upwards, backwards, and to the left side, forming a curve, the convexity of which is directed forwards and to the left side: it has of the appendices of the auricles one on either side of it, and is at first anterior to, but subsequently to the left side of, the aorta. After a course of about two inches within the pericardium, it divides just as it leaves this sac into right and left branches, and is connected at the point of bifurcation by a ligamentous chord to the under part of the arch of the aorta: this chord was originally the ductus arteriosus. The right branch of the pulmonary artery is the longer, and takes a transverse direction behind the descending portion of the arch of the aorta and the vena cava superior to the right lung, where it divides into three branches, which ramify in its interior. The left branch of the pulmonary artery ascends between the left bronchus and first division of the aortic arch, and above the left auricle, to the root of the corresponding lung, where it divides into two branches prior to entering its structure. The *Pulmonary Veins* which collect the blood from the lungs are two in number on each side: in the root of the lung they lie anterior and beneath the corresponding artery, and empty themselves into the left auricle of the heart. The *left Auricle* is of a cuboidal form, occupying the posterior and superior part of the heart; its capacity is smaller than that of the right side, but, like the ventricle, its parietes are thicker and more muscular. Above and to the left side is seen the appendix, which is small and irregular in outline: it overlaps the left border of the pulmonary artery. The interior of this cavity presents similar characters to that of the right side, viz., the musculi pectinati of the appendix; the smooth septum, presenting a less defined depression, marking the original existence of the oval foramen: the orifices of the four pulmonary veins are seen in the posterior wall of the cavity, those of the left side not unfrequently terminating by a common opening, and a short distance below that of the appendix. Lastly, the communication with the left ventricle is seen at the anterior and inferior part of the auricle; it is somewhat smaller, but otherwise similar in character to that of the right side. The *left Ventricle* is conical, like the right, its apex extending quite to the apex of the Heart. It presents an arrangement of muscular fibres similar to those of the right ventricle, than which its parietes are thicker, but its capacity is less. The auricular and arterial openings occupy the upper part or base of this cavity: of these the former is posterior and a little to the left side of the

latter, and is guarded by a valve similar to the tricuspid, but divided into only two folds, whence it is named mitral: the anterior of these laminæ is interposed between the arterial and auricular openings. The position of the *Aortic* orifice is at the upper and anterior part of the ventricle, and the attachment of the Aorta to the Heart does not differ from that of the pulmonary artery. Its interior presents the same disposition of the lining membrane, constituting three semilunar valves, opposite to which the artery presents three small dilatations, which are called the lesser Aortic sinuses: the fleshy fibres of the ventricle are strongly inserted around the festooned border of the middle arterial coat; and its attachment is further strengthened by an annular arrangement of tendinous fibres, which are even present in the angular interval between the convex flaps above described. The whole interior of the Heart is lined by a delicate, smooth, transparent membrane, continuous with that which lines the blood-vessels, and partaking more of the character of the serous than any other class of membranes. It is denominated the *Endocardium*, and is more attenuated in the right than in the left cavities: its thickest part on either side is opposite the auriculo-ventricular and arterial openings.

Structure and Functions of the Heart.—The arrangement of the muscular fibres of the ventricles is oblique or spiral. Each ventricle has its proper envelope, which is perforated at the base and apex. The fibres common to both ventricles wind spirally around the former, and may be traced into the interior of each cavity at the aperture above alluded to. Both the superficial and deep fibres are connected to the tendinous rings at the base of the ventricles, and are found more or less intermingled at different parts. The spiral direction of the superficial fibres is from the base to the apex of the ventricles, the inclination of the anterior set being from right to left. The principal muscular fibres of the auricles are disposed in transverse or oblique bands in different planes, which connect the auricles together, or are appropriated to each individually; an annular arrangement may also be observed around the auriculo-ventricular openings.

The passage of the blood through the heart is effected by the alternate contraction of the auricles and ventricles. Of these, one auricle and one ventricle are appropriated to the pulmonic circulation, and constitute the right side of the heart: the cavities of the left side belong to the systemic circulation. In tracing the course of the blood, it is found to enter the right auricle by the two venæ cavæ, which collect this fluid from all parts of the system. When distended, this cavity contracts and empties itself into the right ventricle, which in turn expels its contents into the pulmonary artery. So far purple or vencus blood is in circulation; but in the lungs, those changes (to be hercafter noticed) by which it becomes decarbonized, take place, and arterial blood is returned by the pulmonary veins to the left auricle. Here the same order of distension and contraction ensues as that which has been described in the right side of the heart—viz., the auricle empties itself into the ventricle, which then propels its contents through the whole system by the large arterial conduit, the aorta. Hence this double circulation has been not inaptly compared in its course to the outline described by the figure 8. It will be evident, from the above description, that the contraction of the auricles must be synchronous with the dilatation of the ventricles, and *vice versâ*. The contraction of the ventricles is called the *systole*, and their dilatation the *diastole* of the heart. The persistence of the heart's contraction is, doubtless, in great measure dependent upon the presence of blood in its cavities, and upon its own especial supply; but the fact that this organ, if removed from the body of a recently killed animal, and placed in warm water, will continue to act rhythmically for a lengthened period when thus isolated, is a proof that these causes alone are insufficient to account for the heart's action. Doubtless, all muscular contraction is associated with nervous influence; and in seeking for that which presides over the heart, anatomy and physiology both indicate the sympathetic as the system to which that influence is due. In this respect, therefore, the fountain-head of the circulation may be placed in the same category with the membranous chylopoietic viscera, which it much resembles in the phenomena above alluded to. In each, analogy will permit the assumption that ganglia (the sources of nervous influence in the sympathetic system) are present in the texture of the organs over which they preside; and are thus capable of exercising a control which, though necessarily limited, is more protracted than that of other nervous centres which do not form an integral part of the muscles they supply. Though it may be difficult to assign the direct cause of the alternate contraction of the auricles and ventricles, it is probably referable to the same law which governs the peristaltic action of the intestines, the wave of which invariably (that is, with rare exceptions, and from the operation of abnormal causes) proceeds in one direction: and it appears not improbable that an inverted action of these cavities, from obstruction or other causes, may account for some instances of sudden death where no important lesion is found.

The muscular strength of the auricles and ventricles, and the relative development of the corresponding cavities on either side of the heart, is proportioned to the amount of exertion required of them. Thus the auricles are little else than passive recipients of the blood, their only active office being to pass that fluid on to the ventricles; and, again, the strength of the left ventricle much exceeds that of the right—an anatomical difference which is readily accounted for by the extent and diffusion of the systemic, as compared with the pulmonic, circulation. The *valves* in and near the heart are the auriculo-ventricular and arterial. As the position and attachment of these have been already described, it only remains to notice the mode in which they perform the office of preventing regurgitation from the ventricles into the auricles, and from the arteries into the ventricles. The position of the tricuspid and mitral valves within the ventricles, and their attachment to the circumference of the aperture between them and the auricles, permit of an uninterrupted progress of the blood from the latter cavities into the former. The fleshy columns, which are attached through the medium of tendinous chords to the free border of the valves, contract coincidentally with the muscular parietes of the ventricle, and thus raise these flaps so as to allow them, during the emptying of this cavity, to be thrown back against the auriculo-ventricular opening; and in this way the natural tendency to a retrograde course of the blood is effectually provided against. The position of the anterior lamina of the mitral

valve, between the auricular and aortic openings from the ventricle, has led (and probably justly) to the belief that it further operates, during the filling of the last-named cavity, as a valve to prevent the gradual escape of the blood into the aorta: it is questionable whether a similar function can be correctly attributed to the tricuspid. The use of the semilunar valves of the aorta and pulmonary artery is similar, the only difference being that they are unprovided with any muscular apparatus, and are, therefore, forced back against the arterial orifice by the regurgitating tendency which is arrested by them. The corpora sesamoidea in these valves complete the little interval, which would otherwise have been left by the adaptation of three convex outlines.

The *sounds*, which are distinctly audible during the action of a healthy heart, consist of one which is comparatively dull and protracted, and synchronous with the systole of the ventricles; and of a second, which is clearer, and more abrupt, and immediately succeeds the former. A period of repose, equivalent to that occupied by the second sound, then intervenes before the first sound is repeated. Many theories have been broached to account for these phenomena, and each has something plausible to recommend it. The most probable appears to be that which attributes the first sound to the impulse of the blood against the auriculo-ventricular valves; and the second to a similar cause, operating in a like manner upon the semilunar valves. It is difficult to say positively why the apex of the heart is projected forwards at each systole of the ventricles: perhaps it is rather to be attributed to the reflected impulse just spoken of, than to any other cause; though, probably, this explanation is not by itself a satisfactory one.

During uterine life the attachment of the *Fœtus* to the placenta, and the vicarious function of the liver, give rise to remarkable deviations in the course of the circulation, which cease immediately after birth. Two arteries (hypogastric) convey the blood from the fœtus to the placenta, and one large vein (umbilical) returns it in a purified condition to the child: the former vessels are continuous with the internal iliac arteries, and the latter passes to the horizontal fissure of the liver. On arriving at this latter point the stream of the blood is unequally divided, a larger portion first passing through the portal system of the liver, and being thence conveyed to the vena cava ascendens by the hepatic veins, and a smaller stream being transmitted directly by the ductus venosus, and through one of the left hepatic veins, into the vena cava. The re-united streams then proceed to the right auricle of the heart. Here a further diversion of a considerable portion of the blood takes place through the foramen ovale into the left auricle, whence it is conveyed through the left ventricle into the aorta. The peculiar attachment and development of the Eustachian valve, at this period of life, seem to indicate that one of its uses is to direct the stream from the inferior cava to the communication between the auricles. Some portion of the blood, however, takes the same course as in extra-uterine life, and is thus conveyed into the pulmonary artery; but the greater part of this divided stream is diverted in its progress towards the lungs, and conveyed by the ductus arteriosus into the aorta, being thence distributed, in company with the stream which passed directly from the right to the left auricle, throughout the system. Lastly, at the bifurcation of the common iliac arteries the current is once again unequally divided, the larger division passing along the internal iliac and hypogastric arteries, and thus arriving at the placenta. The blood is returned from the lungs, and all parts of the system, in the same way as after birth. Whatever may be the proximate cause of the altered course of the blood immediately after birth, it is clearly associated with the act of respiration: and, therefore, it may be fairly concluded that the enlargement of the thorax, and expansion of the lungs, operate most importantly in diverting the circulating fluid from its accustomed course up to the period of birth; and it may also be presumed that these causes operate both positively and negatively—positively by soliciting the circulation through the lungs, and negatively by withdrawing it from the circuitous course it takes during fœtal life.

Arterial System. (*Das Arteriensystem*, Germ.; *Le Système Artériel*, Fr.)

The *Aorta* is the main systemic arterial trunk. It is attached, as already described, to the base of the left ventricle, from which cavity it conveys the purified scarlet blood over the whole frame. The commencing portion of the aorta is in the form of an *Arch*, which is divided into three segments, named according to their course, and terminating on the left side of the third dorsal vertebra. The first or ascending division of the arch passes upwards, forwards, and to the right side, being, at its highest point, on a level with the cartilage of the second rib: the middle or transverse portion still inclines slightly upwards, at the same time passing backwards and to the left side of the second dorsal vertebra, where the descending division commences, and takes a vertical direction to be continuous with the thoracic aorta. The ascending segment of the arch lies almost entirely within the pericardium, having the vena cava superior to its right side, the main trunk of the pulmonary artery to its left and overlapping it below, and the right branch of that artery behind it: anteriorly it approaches the sternum above. The transverse division of the arch rests upon the trachea a little above its bifurcation, and is crossed by the left pneumogastric nerve, the recurrent branch of which winds to its posterior aspect: the left brachio-cephalic vein crosses its upper border, and the ligamentous remains of the ductus arteriosus are attached to its under part. The descending portion of the aortic arch corresponds to the left side of the bodies of the second and third dorsal vertebræ, being covered by the root of the left lung, and lying between the œsophagus and thoracic duct on the right, and pleura on the left side. Through the remainder of its course, until it reaches the diaphragm, the aorta is called *Thoracic;* and below that point to its bifurcation it receives the name of *Abdominal.* In viewing the artery through the whole course of its descent, it is found to follow the curvatures of the spine, to which it is closely applied, holding nearly a median position as it passes from one cavity to the other, but being quite to the left of middle line, both in the thorax and abdomen. Its relations, whilst superior to the diaphragm, are, anteriorly to the pericardium, root of the left lung and left auricle above, and the œsophagus, lower down: the vein or veins which collect the blood from the left intercostal spaces pass behind it: the reflected pleura covers it on the left; whilst the

other contents of the posterior mediastinum, viz., the vena azygos, thoracic duct, and œsophagus lie on its right. In passing into the abdomen, the aorta pierces the crura, so as to be invested by them for a considerable distance. As it descends, it inclines to the left side, and bifurcates usually on the fourth lumbar vertebra. In this course, the right crus of the diaphragm, receptaculum chyli, sympathetic nerves, and left lumbar veins separate it from the spine: the pancreas, arch of the colon, stomach, and small intestines, with the omentum and mesentery lie anterior to it, and the left renal vein crosses it: the left crus of the diaphragm lies to its left side, and the vena cava ascends on its right, but is separated from it above by the right crus of the diaphragm, lobulus spigelii of the liver, commencement of the vena azygos, and thoracic duct. The branches of the Aorta are derived severally from its arch, from its thoracic and from its abdominal divisions. Those of the arch are five in number, viz., two coronary, right brachio-cephalic or innominata; left carotid, and left subclavian.

Arteria Coronaria dextra vel posterior arises from the commencing portion of the aortic arch, immediately external to one of the semilunar valves, and to the right of the pulmonary artery. It takes a tortuous course along the groove which separates the right auricle and ventricle to the posterior aspect of the heart, where it divides into two branches: the smaller of these continues in the same groove, whilst the larger descends posteriorly on the septum of the ventricles to the apex of the heart. Each of these branches ultimately anastomoses with corresponding branches from the left coronary artery; and in their course the following parts are supplied: the commencement of the great vessels; the right auricle and auricular septum; both ventricles (especially the right), and their septum. Some of these twigs are separated before the bifurcation of the trunk: the two branches further communicate with each other.

Arteria Coronaria sinistra vel anterior is smaller than the right, and has a similar origin, but the pulmonary artery intervenes between them. It takes its course downwards, forwards, and to the left, under cover of the left auricular appendage, and likewise divides into two branches; one of which, as in the former case, is lodged in the corresponding (left) auriculo-ventricular groove, and terminates by anastomosing with the superior branch of the right artery. The inferior and larger branch descends on the ventricular septum anteriorly, and inosculates with the inferior division of the right artery. By this artery the left side of the heart is supplied: twigs are also given to the commencement of the great vessels, and to the right ventricle; but the left ventricle receives the largest supply.

Arteria Brachio-cephalica vel Innominata is a large trunk, which, after a short course, divides into right carotid and subclavian arteries. It is the first branch arising from the transverse division of the aortic arch. Its course is upwards, with an inclination backwards and to the right side; and it bifurcates opposite the right sterno-clavicular articulation, the average length of the trunk in the adult very little exceeding an inch. This artery lies behind the sternum, and is first related to the trachea, in front of which it arises: at its bifurcation it is on the right side of the air-tube. Its origin is overlapped by the left brachio-cephalic vein; the middle thyroid veins lie on its left side; and the pneumogastric nerve is on its right, closely approaching it above at its termination, but separated below.

Arteria Carotis sinistra arises from the transverse portion of the arch of the aorta, close to the arteria innominata, where it is covered by the sternum and sterno-hyoid and thyroid muscles. Its direction is upwards, and it inclines at the same time to the left side, so as to leave the trachea on its right. Its origin is crossed by the left brachio-cephalic vein, and its outer border overlapped by the left jugular vein. Its course for some distance is nearly parallel to the left subclavian artery; and the thoracic duct lies imbedded between these vessels.

Arteria Subclavia sinistra arises on the left side of the corresponding carotid, from the third division of the arch of the aorta opposite the second dorsal vertebra; and ascends nearly vertically, with a slight inclination towards the left side, to the inner border of the anterior scalenus muscle. In this course it is nearly parallel to the left carotid, which, with the œsophagus, is internal to it: externally and in front it is in contact with the bag of the left pleura, which separates it from the lung: it is crossed superficially near its origin by the left pneumogastric nerve; and the left brachio-cephalic vein overlaps it above: the sternum and sternal muscles also cover it. Lastly, it lies upon the vertebræ, longus colli muscle, and inferior cervical ganglion of the sympathetic.*

Arteriæ Carotides communes.—The carotid artery of the right side arises opposite the sterno-clavicular articulation from the innominata: that of the left side, gains a corresponding position by taking the course already described. The two vessels diverge as they ascend, and usually bifurcate opposite the upper border of the Thyroid cartilage. Each vessel is deeply placed in the lower part of the neck, but comparatively superficial above: in the former position it lies beneath the platysma-myoides, sterno-mastoid, hyoid and thyroid, and omo-hyoid muscles; whilst in the latter, *i. e.* opposite the cricoid cartilage, and above the point of separation of these muscles, it is covered by the platysma and fascia alone. The crossing of the omo-hyoid muscles further divides the course of the common carotid artery into inferior and superior portions. Below, the two arteries are near to each other, but above they are separated by the œsophagus and trachea, and higher up by the larynx and pharynx: the thyroid body is also interposed between them, and its lobes (especially if large) more or less overlap them. Posteriorly each vessel is related to the inferior thyroid artery, the sympathetic and recurrent laryngeal nerves, which separate it from the spine and longus colli muscle: the vertebral artery is also behind it, but soon enters the foramina in the cervical transverse processes. The external relations of the common carotid are the internal jugular vein and pneumogastric nerve, which lie in the same sheath with it, the nerve being between the vessels. The descendens lingualis nerve, and some irregular thyroid veins, lie superficial to the carotid sheath; some lymphatic glands are also found closely connected to it, lying principally to the outer side.

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* As the preceding descriptions embrace the principal peculiarities of the left carotid and subclavian arteries, and as the vessels of either side agree in the rest of their course, one description will suffice for both.

Arteria Carotis Externa, and its Branches.—This vessel separates from the internal artery of the same name opposite the upper border of the thyroid cartilage: sometimes the bifurcation of the common carotid is as high as the os hyoides, but rarely lower than the point above indicated. The destination of the External Carotid is to supply the neck, face, and exterior of the head. It first ascends with an inclination inwards towards the submaxillary gland, but soon turns backwards to enter the substance of the parotid, in which it divides into its ultimate branches. In this course it runs parallel to the Vertical ramus of the lower jaw, between it and the external auditory opening; and presents a curvature below, the convexity of which looks upwards and inwards towards the tonsil. It is covered superficially by the platysma and fascia, and is crossed by the digastric and stylo-hyoid muscles, and by the lingual motor nerve: in the substance of the parotid, and near to its termination, it is further crossed by the facial nerve. The stylo-glossus and stylo-pharyngeus muscles, and the glosso-pharyngeal nerve, with the stylo-hyoid ligament separate it from the internal carotid: and the point of bifurcation into its terminating branches is opposite the neck of the lower jaw. Several branches of the sympathetic nerve surround the External Carotid and its divisions. *Arteria Thyroidea superior* is the first branch of the external carotid, and arises usually opposite the cornu of the os hyoides. In its course to the thyroid body it forms an arch, the convexity of which looks upwards, and it is covered by the platysma and fascia, and the omo-hyoid and sterno-thyroid muscles. Its branches are,—1. Hyoidean, which is small, and passes inwards between the os hyoides and thyroid cartilage, and beneath the thyro-hyoid muscle: it communicates with its fellow. 2. Laryngeal branch, more considerable in size, accompanies the superior laryngeal nerve beneath the thyro-hyoid muscle, to the thyro-hyoid membrane, which it penetrates: it divides into branches, which supply the small muscles of the larynx, the epiglottis, and neighbouring mucous membrane. 3. Posterior branch, which crosses the carotid sheath to be distributed to the lymphatic glands and sterno-mastoid muscle. 4. Thyroid branch, which is the continuation of the trunk, takes a tortuous course along the border of the thyroid gland, and divides into branches which enter its substance and ramify on it superficially: they anastomose with the inferior thyroid of the Subclavian, and with corresponding branches from the opposite side. *Arteria Lingualis*, is usually the second branch of the external carotid: it first passes inwards towards the os hyoides, and then ascends to the under part of the base of the tongue: its third division comprises its course along this organ to its tip. In the first division of its course the cornu of the os hyoides separates the lingual from the thyroid artery, where they are covered only by the platysma and fascia. The former then passes more deeply beneath the hyo-glossus muscle, having also the mylo-hyoideus superficial, and the middle constrictor of the pharynx internal to it. Further on it is placed between the hyo-glossus and genio-hyo-glossus muscles; and, after leaving the former, it continues its course between the latter and the lingualis to its termination. The lingual motor nerve at first lies superficial to and above the artery: the hyo-glossus then separates them, the nerve being still superficial; but from the anterior margin of that muscle they run together to their termination. The lingual artery gives off the following branches:—1. Hyoidean, which is distributed to the muscles attached to the hyoid bone, and to the epiglottis: it anastomoses with its fellow and branches of the thyroid. 2. Dorsal branch of the tongue, arises in the second stage of the artery, and is very frequently substituted by several small twigs: it supplies the tonsil, palate, base of the tongue, and neighbouring mucous membrane. 3. Sublingual, supplies the gland of that name, and the neighbouring mucous membrane of the mouth. 4. Ranine, which is the continuation of the trunk, supplies the structure of the tongue, and its muscles near their insertion; also the mucous membrane of this organ, at the tip of which it anastomoses with its fellow. *Arteria Facialis*, called also labial and external maxillary, arises from the external carotid next to the lingual. The course of this branch is very tortuous from its commencement almost to its termination. It first passes upwards and inwards so as to approach the tonsil, and is covered by the digastric and stylo-hyoid muscles: it next penetrates the substance of the sub-maxillary gland; and, on emerging from it, winds over the horizontal ramus of the lower jaw in front of the masseter muscle. In its subsequent course it lies imbedded in the fat of the cheek, and is crossed successively by the depressor anguli oris, zygomaticus, and part of the levator labii superioris. Its branches are:—1. Inferior palatine, which ascends inwards between the stylo-glossus and stylo-pharyngeus muscles to the palate, which, together with the pharynx, tonsils, and above-named muscles, it supplies; and anastomoses with the palatine branch of the internal maxillary. A distinct branch is frequently separated to the tonsil. 2. Glandular branches supply the submaxillary gland. 3. Submental, a considerable branch, runs parallel to and beneath the horizontal ramus of the lower jaw, under cover of the platysma: it supplies the muscles and glands in this region, and ultimately divides into two branches; one of which gains the median line, where it anastomoses with its fellow, whilst the other is distributed to the skin and muscles of the chin, communicating with twigs from the inferior labial and dental arteries. 4. Inferior labial, supplies the muscles and skin of the under lip, and communicates with those just named. 5. Inferior coronary, runs inwards beneath the depressor of the lower lip and orbicular muscle, and close to the mucous membrane, to supply these parts and join the corresponding branch from the opposite side. 6. Superior coronary, arises near the labial commissure, and has a similar distribution and termination in the upper lip, as the last described has in the lower. 7. Lateral nasal, is distributed to the side of the nose, and anastomoses on the back of that organ with its fellow. 8. The angular artery is the terminating branch of the facial: it ascends between the origins of the levator labii superioris alæque nasi to the inner canthus of the eye, where it is distributed to the neighbouring lachrymal apparatus, and inosculates with branches of the ophthalmic artery. 9. Muscular branches are distributed, in the course of the facial artery, to the masseter, buccinator, and other facial muscles. *Arteria Sterno-mastoidea*, usually comes directly from the external carotid artery, and passing backwards to the sterno-mastoid, supplies it and the deeper muscles. *Arteria Occipitalis* arises from the external carotid usually opposite to the lingual artery. Its course is first upwards and backwards,

parallel to the posterior belly of the digastric, which covers it, and by which it is directed to the mastoid process of the temporal bone: from the groove on the inside of this process it passes backwards on the occipital bone, and subsequently ascends on the back of the head to divide into its terminating branches. In the early part of its course this artery lies beneath the sterno-mastoid muscle and fascia of the neck, and the lingual motor nerve crosses it in its arched progress to the tongue. It then lies between the mastoid process and transverse process of the atlas, which position it gains by crossing the internal jugular vein and pneumogastric nerve. Lastly, on the occiput before it becomes subcutaneous, it is covered by the splenius capitis muscle, having the trapezius, trachelo-mastoid, and complexus also superficial to it. 1. The Occipital artery gives off several muscular branches to supply the muscles with which it is related: some of these are superficial and anastomose with the superficial cervical, and others are deeply seated and communicate with the deep cervical artery, both branches of the subclavian. 2. It gives off a meningeal branch, which enters the posterior lacerated foramen; and sometimes another which penetrates the mastoid foramen. 3. The terminating branches are tortuous, and correspond to the occipito-parietal suture: they are distributed to the skin and muscles of the scalp, being accompanied by the posterior branch of the first cervical nerve, and anastomosing with the opposite, and with the temporal and posterior aural arteries. *Arteria posterior auris* is small, and when regular, arises a little above the last, after the carotid has entered the parotid gland: sometimes it comes off in common with the occipital. Its course is upwards and backwards between the ear and mastoid process, where it divides. 1. Before bifurcating, this artery gives branches to the muscles and parotid gland. 2. The stylo-mastoid branch is supplied by it, and enters the Fallopian aqueduct by the stylo-mastoid hole: it is distributed to the labyrinth, and anastomoses with other branches supplying the internal ear. 3. Of its terminating branches, one is distributed to the concha, and the other to the mastoid region of the skull. *Arteria Pharyngea ascendens*, even smaller than the last, is usually the earliest branch of the external carotid. It takes a deep course close to the spinal column and pharynx, being crossed by the stylo-pharyngeus muscle, and having the superior cervical ganglion external to it: it lies upon the rectus capitis anticus major muscle. 1. The principal branches of this artery are distributed to the pharyngeal muscles; and many of them supply the Eustachian tube, velum, palate, and tonsil. 2. The great nerves in this region receive branches. 3. Some are distributed to the anterior deep muscles of the neck. 4. The terminating branches are the meningeal, which enter the skull by its posterior and anterior lacerated foramina, and by the anterior condyloid hole: of these the first is the most considerable and constant. *Arteria Transversalis faciei*, arises in the substance of the parotid gland, either from the external carotid itself immediately prior to its ultimate bifurcation, or from the temporal close to its origin. It emerges from the parotid gland and takes a transverse course across the masseter muscle, in company with Steno's duct, above which it lies, and from which it is separated by a large branch of the portio-dura nerve. The branches of this artery are distributed to the parotid gland, and to the masseter and other muscles of the face. They anastomose with branches of the facial artery. *Arteria Temporalis*, is the superficial of the two branches which result from the bifurcation of the external carotid artery: it is somewhat smaller than the deep branch. Its course is vertical; and after emerging from the parotid gland it ascends behind the base of the Zygoma to the temporal region, where it divides into anterior and posterior branches. In this course it is crossed by the anterior auris muscle, and covered by fascia, which accompanies it from the parotid gland: branches of the facial nerve also twine around it. The branches of this artery are distributed, 1. to the anterior part of the auricle and capsule of the lower jaw; 2. a deep temporal branch, which is distributed to the muscle of that name after penetrating the temporal aponeurosis; 3. the anterior terminating branch passes forwards and is distributed to the skin and muscles of the forehead, anastomosing with the supra-orbitar and frontal arteries, and with its fellow; 4. the posterior terminating branch arches backwards, having a similar distribution, and communicating with the occipital and posterior aural arteries. *Arteria Maxillaris interna* leaves the temporal to pass inwards beneath the neck of the lower jaw, where it is covered by the internal lateral ligament of the temporo-maxillary articulation. The subsequent course of this artery is very tortuous: it first curves inwards to the interval between the pterygoid muscles above and below, and the buccinator and insertion of the temporal internally and externally; it then crosses between the external pterygoid and temporal muscle; and lastly penetrates the former to enter the pterygo-maxillary fossa. In this course the artery is nearly related to the divisions of the inferior maxillary nerve, usually separating the dental from the lingual branch. The following are the branches given off by this complex and tortuous artery. 1. Middle Meningeal is the first and generally the largest offset from the Internal Maxillary artery. It arises whilst that trunk is on the side of the neck of the jaw, and arrives at the base of the skull by passing behind to the external pterygoid muscle, and between the tensor palati and internal lateral ligament of the temporo-maxillary articulation. It then enters the cranium by the spinous foramen of the sphenoid bone, and ascending on the temporal and parietal bones between the dura mater and skull, it ultimately divides, and its ramifications extend in an arborescent form over the vault of the cranium. Before this artery enters the skull it gives off twigs to the surrounding soft parts, and the Eustachian tube. Within the skull it sends small branches into the orbit through its lacerated foramen, and one to the ear through the hiatus Fallopii. The trunk and branches of this artery groove the bone almost to their termination, and supply the inner table of the skull and diploe with blood. 2. Inferior Dental artery arises near to the last, and passes between the vertical ramus of the lower jaw and internal lateral ligament to enter the dental canal, which it traverses, in company with the nerve of the same name, as far as the first molar tooth: it here divides into two branches, one of which is a continuation of the trunk within the canal, and destined to supply the canine and incisor teeth; whilst the other escapes by the mental foramen, and divides into a lash of branches distributed to the skin and muscles of the lower lip and chin, and communicating with branches of the facial. Before entering

the dental canal, this artery supplies the pterygoid and mylo-hyoid muscles; and in the canal each molar tooth receives a branch before its division. 3. The muscular branches of the internal maxillary artery are pterygoid to the two muscles of that name; temporal (usually two), which supply the temporal muscle, and communicate with branches from the superficial temporal; masseteric and buccal, which are distributed to these muscles and the surrounding soft parts. 4. The superior dental branch winds tortuously round the tuberosity of the upper jaw, and sending some twigs in for the supply of the antrum, its remaining branches penetrate the alveoli, and are distributed to the molar teeth. 5. The infra-orbitar branch leaves the spheno-maxillary fossa to enter the infra-orbitar canal, which it traverses in company with and beneath the nerve of the same name, and appears on the cheek between the levator labii superioris and levator anguli oris: in this course it gives off twigs to the antrum, canine, and incisor teeth; and on the face is distributed to the skin and muscles, and communicates with the other arteries in the neighbourhood. 6. The descending palatine branch descends through the posterior palatine canal to the palate, having previously given off the vidian twig: its ultimate distribution is to the velum and palate. 7. The lateral nasal enters the superior chamber of the nose by the spheno-palatine foramen, and is distributed to the upper part of the pharynx and mucous membrane of the nasal fossæ.

Arteria Carotis Interna, and its Branches.—The size of this artery is much the same as that of the external carotid in the adult, but considerably exceeds it in the child, at which period the brain is disproportionately developed. Its course is generally divided into three stages, the first of which includes the course of the artery before it arrives at the base of the skull; the second its course through the carotid canal, and the third, its progress through the cavernous sinus before its ultimate division. In its directions and relations, this artery appears as the continuation of the common carotid; for its course is vertical though flexuous: it has the internal jugular vein on its outer side, and par vagum on its inner, and it rests on the rectus capitis anticus muscle and sympathetic nerve. The Internal Carotid lies on a plane external and posterior to the external carotid, and the two vessels are separated, as already stated, by two of the styloid muscles, the stylo-hyoid ligament and glosso-pharyngeal nerve: a portion of the parotid gland is also interposed. When close to the base of the skull, the former vessel is immediately behind the Eustachian tube, and internal to the styloid process; whilst it lies close to the pharynx, and has the tonsil anterior and internal to it. In the carotid canal and sinus the artery is very tortuous, making abrupt turns to accommodate itself to the direction it is required to take; in the latter position its curves resemble the Roman letter S. Its ultimate direction is backwards and inwards, when it terminates on the side of the olivary process of the sphenoid bone, by division into the cerebral arteries. In this course the artery is accompanied by filaments of the sympathetic nerve, and is surrounded by an investment of the lining venous membrane in the cavernous sinus. The relation of the orbitar nerves and artery has been already described.* Whilst situated close to the tympanum, anterior and internal to which it lies, this artery gives off a small tympanitic branch: and just before its ultimate division the ophthalmic artery is separated.* The terminating or cerebral branches of the internal carotid are the following:—1. Choroid branch takes a direction backwards, and enters the inferior cornu of the lateral ventricle, to be lost in the choroid plexus. 2. Lateral communicating branch proceeds backwards and inwards to communicate with the posterior artery of the cerebrum, a branch of the basilar. 3. Anterior artery of the cerebrum passes forwards and inwards above the optic nerve, to the great longitudinal fissure of the brain, and when near the corresponding artery of the opposite side, the two vessels communicate by a large intermediate branch, called the anterior communicating artery. The main vessel then passes backwards in company with its fellow along the corpus callosum, distributing its branches, in its progress, to this commissure, and to either hemisphere of the cerebrum. 4. Middle cerebral artery, considerably larger than the latter, takes its course outwards and backwards to the fissure of Sylvius, and is distributed to both anterior and middle lobes of the cerebrum, but especially the latter.

Arteriæ Subclaviæ, of equal size with the carotids, are two in number, their destination being to supply the upper extremities. The origin and early course of each has been already described. The scalenus muscle crosses each subclavian artery in its progress, and has given rise to an arbitrary, though useful, division of the vessel into three parts; the first comprises that portion of the artery which is internal to the muscle, the second that which is behind it, and the third includes the remaining portion of the vessel until it assumes the title of axillary. By referring to the preceding description of the branches as they arise from the arch of the Aorta, it will be perceived that the extent of the right subclavian artery behind the scalenus muscle is comparatively short. Whilst covered by this muscle, the corresponding vein is separated by it from the artery, the former lying on a plane anterior and a little inferior to the former, and more closely connected to the clavicle: the phrenic nerve lies on the anterior scalenus, and is therefore also anterior to the artery, but behind the vein; the brachial nerves are superior and posterior to both vessels. Further, the artery is related posteriorly to the posterior scalenus muscle and summit of the pleura. From the outer border of the scalenus anticus muscle to the lower margin of the first rib, the Subclavian artery lies behind the clavicle and subclavius muscle, in the posterior inferior triangle of the neck. Here the vein is in contact with the artery, but still anterior and inferior to it; and the brachial plexus is more closely applied upon it, so as in part to lie behind it: the supra-scapular artery is parallel and anterior to the Subclavian; whilst the posterior scapular artery and omo-hyoid muscle are above it. Lastly, in this, its third division, each Subclavian artery rests on a portion of the posterior (or middle) scalenus muscle, and grooved upper border of the first rib. The *branches* of the Subclavian artery are subject to considerable variety in their origin, but usually regular in their destination: the ordinary number is five. The *Vertebral* is the largest, and generally the first branch given off from the trunk, whilst internal to the Scalenus

* See 'Organs of Senses,' p. 435.

* This has been already described with the 'Organ of Sight,' p. 435.

muscle. It ascends, inclining at the same time a little outwards, to arrive at the root of the transverse process of the sixth cervical vertebra, the foramen in which it enters: in this course it lies on the longus colli muscle. In its subsequent course the Vertebral artery passes in succession through the holes in the cervical transverse processes until it reaches the atlas, where its first curve outwards is formed for it to gain the foramen in the transverse process of that vertebra: its second curve is nearly horizontal, the artery inclining backwards to pass behind the articulation of the atlas and occiput, and lying in a deep groove in the former: lastly, it is directed forwards and upwards through the foramen magnum of the occipital bone; and the two arteries converging as they lie on the antero-lateral aspect of the medulla oblongata, ultimately unite to form a single trunk, the Basilar, opposite the junction of the spinal cord and meso-cephalon. Before this junction is effected the following branches are given off from either vertebral artery; 1. small twigs to the spinal nerves: 2. Posterior spinal artery inclines to the back part of the cord, and descends even to the lumbar region, supplying in its progress the cord itself and its investments, and anastomosing with other twigs which enter the vertebral foramina: 3. the Anterior spinal artery, generally arising higher than the last, soon joins its fellow to form a single trunk, which descends tortuously along the anterior part of the cord, even to the cauda equina, in which it ultimately terminates: it gives off supplying and inosculating branches similar to the preceding: 4. the inferior cerebellar artery sometimes comes from the Vertebral, at others from the Basilar; it takes a flexuous course between the branches of the eighth pair of nerves, and is ultimately distributed to the back and lower part of the cerebellum: 5. as the Basilar artery crosses the pons it gives twigs to it: 6. on its anterior and superior extremity the superior cerebellar artery is detached; it winds round the crus cerebri to the upper part of the cerebellum, where it divides into its ultimate branches: 7. the Basilar artery lastly bifurcates immediately after the origin of the last branches, and the resulting pair of vessels is the posterior cerebral: these likewise wind round the crus cerebri, and above the tentorium to the under surface of the posterior lobe of the cerebrum, where they are distributed: in their progress they receive the lateral communicating arteries from the carotids, by which the circle of Willis is completed.* The *internal Mammary* artery arises from the Subclavian opposite the vertebral, and therefore also internal to the Scalenus muscle. Its course is nearly vertical through the chest, and closely applied to its anterior parietes. At first this artery inclines a little forwards and inwards, and is crossed by the phrenic nerve, which subsequently lies to its inner side. In its progress downwards it is interposed, first between the parietal pleura and costal cartilages, and afterwards it insinuates itself beneath the triangularis sterni muscle, its distance from the sternum being less than an inch. The mammary artery gives off from its inner border branches to the muscles and glands in the anterior mediastinum: 2. the comes nervi phrenici, which is ultimately lost in the diaphragm: 3. anterior intercostal and perforating branches, which supply these muscles and the mamma, and anastomose with the proper intercostal and thoracic arteries. Of the two terminating branches the external runs near the margin of the diaphragm, which and the neighbouring intercostal muscles it supplies; whilst the internal or proper abdominal branch descends upon the peritoneum, distributing twigs to the abdominal muscles, and inosculating freely with the terminating branches of the epigastric, lumbar, and circumflexa ilii arteries. The *Thyroid axis* arises from the Subclavian internal to the Scalenus muscle, and nearly opposite the mammary: it is a very short trunk, which inclines upwards and soon divides into four branches. 1. Inferior thyroid is the largest branch: it takes a flexuous course upwards and inwards behind the carotid sheath and sympathetic nerve, and lies upon the longus colli muscle. After supplying twigs to the œsophagus and trachea it terminates in the thyroid body, where it anastomoses with the superior thyroid and its fellow. The left thyroid artery has the thoracic duct also anterior to it. 2. The ascending Cervical branch comes from the last described, or directly from the axis: its course is upwards on the anterior scalenus muscle, parallel and internal to the phrenic nerve; and it is distributed to the deep muscles of the neck, sending branches in through the vertebral foramina, and communicating with the occipital. 3. The Supra-scapular branch (or transversalis humeri) takes a horizontal course to the notch in the upper border of the scapula, crossing anterior to the scaleni muscles and the phrenic and brachial nerves, and lying behind the clavicle, and close to the subclavius muscle: the artery enters the supra-spinous fossa, by crossing above the ligament of the notch; and, after supplying the muscle of this region, proceeds onwards beneath the spine of the scapula to the infra-spinous trench, where it terminates by distribution to the infra-spinatus and teres minor muscles, and by inosculation with the other two scapular arteries. 4. The Posterior Scapular (or transversalis colli) artery takes a parallel and similar course to the last, but superior to it, to arrive at the superior internal angle of the scapular: this branch gives off inconsiderable twigs to the muscles; and the superficial cervical artery, which ascends beneath the trapezius muscle, to which and the neighbouring muscles and glands it is distributed, anastomosing with branches of the occipital. At the superior angle of the scapula the levator anguli scapulæ covers the posterior scapular artery, and receives a branch from it, which also supplies the supra-spinatus muscle; another branch passes outwards beneath the scapula to be distributed to the subscapularis and great serratus; whilst the continued trunk descends along the base of the scapula under cover of the rhomboid muscles, to which and others in the neighbourhood it is distributed, ultimately anastomosing with the subscapular artery. The remaining two branches of the Subclavian artery come off in its middle stage, and not infrequently arise in common. The *Superior Intercostal* artery descends in front of the neck of the first two ribs, sending off a branch which is distributed to the first intercostal space; and then in like manner supplying the second, and communicating with the first intercostal branch of the Aorta. The first thoracic ganglion is external to this artery. The *Deep Cervical* branch takes its course backwards between the transverse processes of the last two cervical vertebræ, and through the brachial plexus of nerves: it then ascends in the interval between the

* See 'Internal Carotid,' p. 468.

transverse and spinous processes of the vertebræ, and is distributed to the muscles of this region, communicating with the deep descending branches of the occipital artery.

Arteria Axillaris, or continuation of the subclavian through the axilla, commences opposite the lower border of the first rib, and extends to the lower margin of the teres major and latissimus dorsi muscles, where the brachial begins. In this course it is crossed by the pectoralis minor muscle, which thus divides it into three stages. Above this muscle the artery lies under cover of the great pectoral, and upon the first intercostal and second digitation of the great serratus muscle; the costo-coracoid ligament also lies in front of it; whilst behind the small pectoral muscle, the brachial nerves begin to surround the artery. Still lower the artery is more closely approximated to the Shoulder-joint, from which it is only separated by the insertion of the subscapular muscle: and lastly, it lies upon the conjoined tendons above mentioned, being still under cover of the pectoralis major.* The accompanying vein is superficial to the artery throughout its course, but lies also to its inner side above. The following are the *branches* of the Axillary artery: 1. *Acromial thoracic* arises opposite the upper border of the small pectoral muscle, and in the interval between the deltoid and great pectoral: after a short course it divides at once into several branches, of which the majority are lost in the surrounding muscles; one large branch passes outwards beneath the deltoid, which muscle and the shoulder-joint it supplies; and a long descending branch accompanies the cephalic vein, and is distributed to the deltoid and great pectoral muscles. 2. *Superior thoracic*, not infrequently a branch of the last, descends between the pectoral muscles to which and to the mamma it is distributed, anastomosing with the perforating branches of the intercostal and mammary arteries already described. 3. *Alar thoracic*, usually two or three small branches which arise lower down, and are distributed to the parietes and glands of the axilla. 4. *Long thoracic* arises below the lesser pectoral muscle, and descends parallel to its inferior border upon the serratus magnus: to these muscles and the great pectoral and subscapularis it distributes branches, and anastomoses with the perforating branches noticed above 5. The *Subscapular* is the largest branch of the Axillary artery; it arises opposite the lower border of the subscapular muscle, and descends for a short distance along the corresponding border of the scapula: opposite the inner margin of the long head of the triceps it divides into an anterior branch, which is the smaller, but continues in the same direction as the trunk to the inferior angle of the scapula; and a posterior branch which winds round the external or inferior costa of this bone, leaving the axilla by the opening which has for its boundaries the triceps, teres major, and subscapular muscles; the destination of the former of these branches is to the adjoining muscles of the scapula and chest, whilst the latter is chiefly distributed to the deltoid, infra-spinatus and teres minor: a free anastomosis is established between this artery and the other branches from the subclavian, on the dorsum and inferior angle of the Scapula. 6. The *posterior circumflex* artery arises near the last, and almost immediately leaves the axilla between the humerus and long head of the triceps, accompanied by the circumflex nerve: it winds round the neck of this bone under cover of the deltoid, in which and on the shoulder it is expended, communicating with the next and the superior profunda of the brachial. 7. *Anterior Circumflex*, much smaller than the last-described, is irregular in its origin; its course is forwards and outwards close to the neck of the humerus; and after supplying the neighbouring muscles and synovial membrane of the shoulder-joint, it terminates by anastomosing with the posterior circumflex.

Arteria Brachialis extends from the teres major tendon to the point of bifurcation of the main trunk at the elbow-joint. In this course it is superficially placed, being only covered by the fascia, which holds the surrounding muscles together, so as to afford a further protection to the artery. It first rests on the triceps, then on the insertion of the coraco-brachialis, and lastly on the brachialis anticus muscles. In the upper third of its course the artery lies between the coraco-brachialis and triceps, and in the two lower thirds between the latter and biceps muscle: the semilunar fascia of the biceps covers it inferiorly. The Brachial artery is accompanied by a vein on either side. The position of the brachial nerves varies in relation to the artery according to its position: the inner cutaneous nerve is superficial, but parallel to it; the median crosses from its outer to its ulnar side; the radial lies behind it above. Just prior to its bifurcation (which takes place nearly opposite the coronoid process of the ulna), the Brachial artery lies between the biceps tendon and median nerve; and, still resting upon the brachialis anticus muscle, it dips in between the supinator longus and pronator teres muscles to gain the deep position in which it terminates. The *branches* of the Brachial artery are; 1. *Muscular*, which are irregular in number, size, and origin, and are distributed to the neighbouring muscles: 2. *Superior Profunda*, which arises soon after the artery becomes Brachial, and accompanies the radial nerve in a spiral direction beneath the triceps, and around the humerus to its outer aspect, where it divides into two branches; one of these descends in the triceps, to which and the elbow-joint it is distributed: the anterior branch continues to accompany the nerve, and is found lodged with it in the interval between the supinator longus and brachialis anticus muscles, where it terminates by anastomosing with the anterior recurrent branch of the radial. 3. The *inferior Profunda* arises opposite the insertion of the coraco-brachialis muscle, and descends in company with the ulnar nerve to the interval between the inner condyle of the humerus and olecranon of the ulna, where the nerve lies superficially: in this course it pierces the intermuscular septum, and lies on the inner head of the triceps, supplying this muscle and the biceps, and inosculating with the posterior ulnar recurrent artery. 4. The *Anastomotic* branch arises below the last, and takes an inward direction to pierce the intermuscular septum above the inner condyle, after which it terminates by anastomosis with the last and the posterior ulnar recurrent; but prior to this it supplies some muscular twigs, and communicates with the inferior profunda and anterior ulnar recurrent. 5. The *Nutritious* branch to the humerus is detached from the trunk about the middle of the arm: it pierces the coraco-brachialis to enter the foramen in the bone,

* For particulars respecting the relation of the nerves to the artery, see 'Nervous System—Brachial plexus,' p. 444.

which is directed upwards, and terminates by being distributed to its cancellated interior.

Arteria Radialis, though smaller than the ulnar, appears in direction to be the continuation of the brachial. Its position is comparatively superficial, being covered by the fascia, and imbedded between the muscles of the fore arm. In its course to the wrist the radial artery first lies on the tendon of the biceps, and then in succession on the supinator brevis, tendon of the pronator teres, radial origin of the flexor sublimis, flexor pollicis, pronator quadratus, and lastly on the base of the radius: the opposed margins of the supinator longus and pronator teres conceal it above; and in the lower two-thirds of its course it lies between the former muscle and the flexor carpi radialis, being partly overlapped by them above, but left exposed between their tendons below. At the wrist-joint the Radial artery winds on the outer side of the carpus to gain a position between the metacarpal bones of the thumb and index finger; and in this course it lies upon the external lateral ligament of the joint, and beneath the extensor tendons of the thumb. Lastly, this artery passes between the origins of the abductor indicis prior to its ultimate division. Through the fore arm two veins accompany the Radial artery, one lying on either side of it; and the anterior branch of the radial nerve lies on its outer side. The *branches* of the Radial are; 1. the *recurrent*, which is of considerable size, and which passes outwards and upwards between the two supinator muscles, and in front of the outer condyle, where it lies in the interval between the opposed margins of the supinator longus and brachialis anticus: it supplies these muscles and anastomoses with the superior profunda. 2. *Muscular* branches to the muscles of the fore arm: these are irregular in number and origin. 3. *Superficialis volæ*, which is given off a little above the wrist-joint, and crosses in front of the annular ligament and origin of the small muscles of the thumb, to join the palmar arch of arteries beneath the palmar fascia. 4. *Anterior carpal* branch crosses inwards beneath the flexor tendons to join a corresponding branch from the ulnar. 5. *Posterior carpal* holds a similar relation to the back of the carpus: it is larger than the last, and supplies the wrist-joint, and anastomoses with the dorsal branch of the ulnar and the interosseous arteries: branches also proceed from the above (or directly from the radial) to be distributed to the posterior interossei, between the metacarpal bones, and to anastomose with the deep palmar arch. 6. *Dorsales Pollicis*, two in number, supply either side of the dorsum of the thumb. 7. *Dorsalis indicis*, sometimes arising with the last, usually terminates by perforating the second interosseous space, and joining the superficial palmar arch. The ultimate branches of the radial are—8. *Princeps pollicis*, which passes to the palmar surface of the thumb between the abductor indicis and pollicis muscles, being placed on the ulnar side of its metacarpal bone, but at the metacarpo-phalangeal articulation dividing into two branches, which supply the ulnar and radial sides of the thumb, and anastomose at its extremity. 9. *Radialis indicis*, supplies the radial side of the index finger, communicating with the digital branch of the palmar arch. 10. *Palmaris profunda* crosses the palmar region towards its ulnar side, lying on the metacarpal bones and interossei muscles, and covered by the flexor tendons and lumbricales: the convexity of this arch is towards the fingers, and from it twigs are detached to supply the interrossei muscles, and communicate with the ulnar arch: it terminates by a free anastomosis with the deep communicating branch of the ulnar artery, opposite the metacarpal bone of the little finger.

Arteria Ulnaris takes a deeper course than the radial, being covered above by the pronator teres, flexor carpi radialis, palmaris longus, and flexor digitorum sublimis: in the middle third of the fore arm, it may be exposed by separating the last-named muscle from the adjoining edge of the flexor carpi ulnaris; and nearer to the wrist it is covered only by the fascia. Throughout this course the ulnar artery rests on the flexor digitorum profundus, except just after its separation from the radial, when it is in contact with the insertion of the brachialis anticus: in passing to the palm it runs superficial to the anterior annular ligament. Two veins accompany the artery, and the ulnar nerve lies to its ulnar side. The branches of the ulnar artery are—1. *Anterior recurrent*, which takes an arched course between the pronator teres and brachialis anticus to the front of the inner condyle, where, after supplying the above muscles, it anastomoses with the anastomotic artery. 2. *Posterior recurrent*, of much larger size, pierces the flexor carpi ulnaris to gain the posterior aspect of the inner condyle, where it is covered by the ulnar nerve: it supplies some muscular twigs, but is principally distributed to the elbow-joint, communicating freely with the three branches of the brachial. 3. The *Interosseous* branch passes backwards to the interosseous ligament, where it divides, after giving off a twig to accompany the median nerve. The anterior branch descends on the interosseous ligament, accompanied by a branch of the median nerve, and covered by some fibres of the adjoining origin of the flexor pollicis and profundus muscles: at the upper border of the pronator quadratus this artery subdivides, one branch supplying the above muscle, and communicating with the anterior carpal arteries, whilst the other perforates the interosseous membrane, and anastomoses with the posterior carpal branches. The posterior interosseal branch, after separating from the anterior, pierces the interosseous membrane, and divides under cover of the anconeus and long extensor muscle, into a recurrent branch, which ascends between the external condyle and olecranon to be distributed to the triceps, and to communicate with the other branches in this region; and a descending branch, which takes its course between the long extensor of the fingers and those of the thumb: these muscles receive their supply from it, and it ultimately communicates with the posterior carpal branches of the radial and ulnar arteries and posterior branch of the anterior interosseous. 4 and 5. *Anterior* and *posterior carpal* branches of the Ulnar artery are distributed as their names denote, and anastomose with those of the radial. Immediately after crossing the annular ligament of the wrist the Ulnar artery terminates by dividing into its ultimate branches, viz.:—6, the *communicating*, which passes backwards between the flexor brevis and abductor minimi digiti to join the deep palmar arch of arteries; and 7, the *superficial palmar arch*: the position of this arch is with its convexity looking downwards and inwards, its course being oblique, and its termination near the centre of the second metacarpal bone: it lies between the palmar fascia and the flexor tendons and median

nerve. From the concavity of this arch several small twigs are detached to the palm; whilst from its convexity the digital branches arise: these are four in number: the first runs on the ulnar side of the little finger; the second and third supply the opposed margins of the little, ring and middle fingers; and the fourth the adjacent borders of the middle and index fingers: each branch therefore bifurcates, and they again unite in the form of an arch on the ungual phalanx of each finger, the last anastomosing with the radialis indicis. They are accompanied by corresponding branches of the median and ulnar nerves, which they usually perforate at the clefts between the fingers.

Aorta Thoracica.—The course of this division of the main arterial conduit has been already traced: its branches, which are numerous but not very considerable, are the following:—1. *Arteriæ Bronchiales*, irregular in number, origin, and size, are usually four, two for either lung. They arise from the aorta opposite the roots of the lungs, and divide prior to entering these organs, into the structure of which they accompany the bronchial tubes. 2. *Arteriæ Œsophageæ*, also irregular in number, arise at different points from the aorta, and are distributed to the œsophagus, communicating with other branches it receives. 3. *Arteriæ Intercostales* are usually nine pairs, and arise from the postero-lateral aspect of the aorta, those of the right side being the longer. The superior branches form an obtuse angle with the aorta at their origin, whilst that of the inferior is acute. Near the heads of the ribs these vessels divide into two branches; the posterior of which pass backwards close to the vertebræ, and are distributed to the spinal cord and muscles of the back: the anterior and larger branch of each runs in the groove of the corresponding rib between the layers of intercostal muscles, which are thus supplied. About the centre of each rib, this, the proper intercostal artery, divides into two branches, the inferior of which is lost on the rib below; the superior continues the same course as the trunk, and ultimately anastomoses with other branches about the chest. The accompanying intercostal vein and nerve lie superior to the artery.

Branches of the Abdominal Aorta.—In its progress through the abdomen the Aorta gives off several branches for the supply of the chylopoietic and urinary viscera; in addition to which the diaphragm, and the testicles and ovaries, respectively in the male and female, receive their arterial supply from the same source. These vessels (some of which are single and others in pairs) will be described in the order in which they arise from above downwards.

Arteriæ Phrenicæ, a pair, are detached from the anterior part of the Aorta whilst that vessel is still between the crura of the diaphragm. The course of each branch is outwards and forwards, that of the left side passing behind the œsophagus, and that of the right behind the vena cava. At the junction of the tendinous and fleshy portions of the diaphragm the phrenic arteries divide into an external branch, which is distributed to the circumference of the muscle, and an anterior branch, which takes a semicircular course to the xiphoid cartilage, distributing twigs in its progress; the former branch anastomoses with the intercostals, and the latter with its fellow and the internal mammary. The œsophagus, pancreas, supra-renal capsules, and semi-lunar ganglia of the sympathetic system also receive twigs from these arteries.

Axis Cœlica.—This short but large stem arises from the Aorta immediately below the last described, and opposite the junction of the dorsal and lumbar regions of the spine. At its origin this vessel has in front of it the stomach, the supra-renal capsule and semi-lunar ganglion, and it is surrounded by the branches of solar plexus. After a course of little more than half an inch, in which the axis is directed downwards, forwards, and to the left side, it divides into three branches, for the supply of the stomach, liver, and spleen. 1. The *Gastric* is the smallest of these branches: its direction is forwards, upwards, and to the left side, to gain the cardiac extremity of the stomach, where it divides. The ascending branch or branches constitute the smaller division of the vessel, and are distributed to the cardiac extremity of the stomach and to the œsophagus, anastomosing with the thoracic œsophageal branches and cardiac branches of the splenic. The larger division is directed along the smaller curvature of the stomach, between the laminæ of the gastro-hepatic omentum, towards the pylorus, where it terminates by communicating with the pyloric branch of the hepatic. In its progress this branch supplies both surfaces of the stomach, and anastomoses freely with the gastro-epiploic arteries. 2. The *Hepatic* is a large and important branch, and, from its destination, might with propriety be named gastro-hepatic. Its course is at first horizontal, between the pancreas and Spigelian lobe of the liver and behind the pylorus, and subsequently forwards, upwards, and towards the right side, to the transverse fissure of the liver. In this course it is enclosed between the layers of the gastro-hepatic omentum, and at its approach to the liver it lies to the left side of the hepatic duct and vena portæ. The branches of the hepatic artery are, *a.* superior pyloric, which is detached immediately above the pylorus, and is distributed to it and the pancreas, anastomosing with the gastric; *b.* Gastro-duodenal, arises immediately after the last, and insinuating itself between the upper part of the duodenum and the pancreas, here gives off the inferior pyloric twigs, and then subdivides; the smaller of the resulting branches is named the pancreatico-duodenal, which runs in the concavity of this intestine, and distributes its branches to it and the pancreas: it communicates with branches of the splenic and mesenteric in the pancreas. The other branch is the principal artery of the stomach, and is called the right gastro-epiploic. Its course is downwards and forwards to gain the convex margin of the stomach, along which it runs between the adherent laminæ of the great omentum towards its left extremity. In this course it distributes branches over the curvatures of the stomach and to the great omentum, and ultimately communicates freely with the left gastro-epiploic, a branch of the splenic. The Hepatic artery at last divides into a branch for either lobe of the liver. *c.* The right hepatic branch gives off the cystic artery which supplies the gall-bladder, and then enters the right extremity of the transverse fissure of the liver. *d.* The left hepatic branch enters the left extremity of the porta or transverse fissure, and is then distributed to the structure of this viscus.* 3. The *Splenic* is the largest of the three branches of the Cœliac axis in the adult. Its course is horizontal,

* For particulars respecting the course and ultimate distribution of the hepatic vessels, the reader is referred to the minute anatomy of the liver, p. 453.

flexuous, and towards the left hypochondrium. It is parallel to, and in connexion with, the superior and posterior part of the pancreas, and lies upon the left crus of the diaphragm and upper part of the left psoas muscle, having the stomach in front. The corresponding vein is parallel but inferior to the artery. In its progress the splenic artery gives off (*a.*) small branches to the pancreas; (*b.*) a large pancreatic branch, which accompanies the duct of the gland; (*c.*) short gastric branches, which traverse the interval between the laminæ of the gastro-splenic omentum to gain the cardiac extremity of the stomach, to which they are distributed, anastomosing with the gastric and epiploic arteries: the trunk lastly divides into (*d.*) five or six branches, which enter the fissure in the gastric surface of the spleen; and (*e.*) the gastro-epiploica sinistra, which is directed towards the left side along the convex or greater curvature of the stomach, to which and the omentum it distributes its branches, and anastomoses with the proper gastric artery and gastro-epiploic branch of the hepatic. Each of the above divisions of the cœliac axis is accompanied by branches of the solar plexus of nerves.

Arteria Mesenterica superior, is also a single trunk, and nearly equal in size to the last described, about a quarter of an inch below which it arises. Its course is long and curved, so that it forms an arch which looks downwards and to the left side. At first it has the pancreas and vena portæ in front, and then crosses the inferior transverse portion of the duodenum and left renal vein. It subsequently insinuates itself between the layers of the mesentery, and proceeds in a curved direction towards the right iliac fossa, having its accompanying vein to its right side. The branches of the superior mesenteric artery are derived from its concavity and convexity: the former supply the large intestine, and are three in number. 1. The *middle colic* is the first of these: it takes its course between the laminæ of the transverse meso-colon, and divides into two branches, which proceed to be distributed to the intestine, and to anastomose with the branches on either side of it. 2. *The right colic* presents a similar arrangement to the last branch, also dividing and inosculating with the neighbouring branches: it is distributed to the ascending colon, as the last is to the transverse arch. 3. *Ileo-colic* branch is the termination of the artery, and usually divides into three secondary branches, which anastomose on the right and left, and supply the termination of the small intestine and the cœcum. Thus a series of arches is formed by the anastomosis of these three arteries with one another; the first also communicating with the left colic branch of the inferior mesenteric. From the convexity of the large arch above described, all the branches for the supply of the small intestines come off: they are fifteen or twenty in number, and lie between the laminæ of the mesentery. By the anastomoses of these also, a series of secondary arches is formed, from which the supplying branches of the small intestines proceed; still, however, forming smaller arches in their progress, and prior to their ultimate arborescent distribution around the intestine.

Arteriæ Capsulares.—There are usually branches, supplying the supra-renal bodies, directly derived from the aorta, above the origin of the renal arteries: others also arise from the phrenic and renal vessels.

Arteriæ Renales.—These vessels arise between the mesenterics, and generally exceed them, and even the cœliac axis, in calibre. The origin of the two arteries does not in general exactly correspond; the right kidney being on a plane a little below the left; its artery also arises lower. Further, from the position of the aorta, the right Renal artery is necessarily longer than the left, having to pass behind the vena cava prior to reaching its destination. Usually the right Renal artery is behind its vein, but the left is superficial to it: as they approach the kidney, however, both veins generally cover their corresponding arteries, the dilated upper extremity of the ureter being behind and beneath them. Before entering the organs they supply, each Renal artery divides into four or more branches.*

Arteriæ Spermaticæ arise below the renal from the anterior part of the aorta: the right often arises from the corresponding renal. The course of these vessels is nearly vertical, but tortuous: in the male they pass to the internal abdominal ring, where they join the spermatic cord: in the female they are destined to supply the ovaries. In their progress both vessels cross the psoas muscle and ureter, the right also crossing obliquely the vena cava. Small branches are detached from these vessels in their course; but their ultimate destination in the male is to the epididymis and proper tubular or secreting structure of the testicle. In the female the Spermatic arteries insinuate themselves between the laminæ of the broad ligament of the uterus, and there divide into branches which supply the ovaries, uterus, Fallopian tubes, round ligament, and inguinal canal.

Arteriæ Lumbales.—These are generally five pairs of arteries, given off from the Aorta at right angles in the lumbar region, opposite the intervertebral substance between each two vertebræ. In their progress outwards these vessels pass behind the sympathetic nerves, and beneath the crura of the diaphragm and psoæ muscles. Their branches are, 1. Spinal, which enter the intervertebral foramina to be distributed to the cord and its theca, as well as to the bones: 2. posterior muscular, which traverse the interval between the several transverse processes, and are distributed to the lumbar mass of muscles: 3. the abdominal branches, which pass between the psoas and quadratus muscle, and, after supplying them, terminate by being distributed to the abdominal muscles, anastomosing with the intercostals, ilio-lumbar, circumflexa ilii, epigastric, and mammary arteries.

Arteria Mesenterica inferior arises from the left side of the aorta, a little above its bifurcation: it is smaller than the superior tery of the same name. Its course is downwards, and towards the left iliac fossa, and it divides into the following three branches: 1. *Left Colic* passes to the descending colon, where it subdivides into a superior branch, which meets the left division of the middle colic artery, and an inferior branch which communicates with the sigmoid: it is ultimately distributed to the descending colon: 2, the *sigmoid* branch passes to the left iliac portion of the colon, where it is similarly distributed: 3, the *superior Hæmorrhoidal* is the largest of these branches: it descends between the layers of the meso-rectum, along the posterior part of the rectum, to within a few inches of its extremity, where it divides and subdivides into branches which supply this gut: some smaller branches

* For the distribution of these vessels, see 'Kidney, Minute Anatomy of,' p. 488.

are also detached before the above division: this artery communicates with the other hæmorrhoidal branches of the internal iliac and pudic.

Arteria Sacra media is the last branch of the aorta before its bifurcation, for it comes off from the angle of the fork between the two iliacs, and sometimes arises from the right iliac. It takes a vertical direction along the middle of the sacrum to the coccyx, dividing into branches which supply the rectum and muscles in this region, and communicate with the hæmorrhoidal and lateral sacral arteries.

Arteriæ Iliacæ communes.—These vessels result from an equal division of the Aorta on the body of the fourth lumbar vertebra, or the intervertebral substance between it and the fifth. The angle formed by the divergence of these arteries, as they descend, is acute; but less so in the female than the male, on account of the greater expanse of the pelvis in the former: opposite the sacro-iliac articulation they divide into external and internal iliac arteries. Each common Iliac artery has the psoas muscle externally, and is covered by peritoneum: the ureters cross them at their points of bifurcation. The right artery is further covered by the ileum just prior to its joining the cœcum; and the left is in like manner concealed by the commencement of the rectum. In consequence of the position of the Aorta, the right Iliac artery is a little longer than the left. The relation of these vessels to the corresponding veins is, that the artery of the right side crosses both the common iliac veins, and conceals them where they unite to form the inferior cava; whilst the left Iliac artery only overlaps the outer border of its corresponding vein. When these vessels give off branches prior to their bifurcation, they are very trivial and unimportant, being distributed to the ureter, peritoneum, &c.

Arteria Iliaca interna.—This, which was the larger of the two branches of the common Iliac in the fœtus, in consequence of its then forming the main conduit by which the blood flowed from the child to the placenta, is in the adult smaller than the branch destined for the lower extremity. The internal Iliac forms a curve which faces forwards, as it descends towards the great sciatic notch. It is covered by the pelvic viscera, and crossed superficially by the ureter and vas deferens: behind it lies the corresponding vein and lumbo-sacral nerve. The ligamentous remains of the hypogastric artery ascend from near its termination to the umbilicus, being usually pervious for a short distance, and giving off one of the vesical arteries. The branches of the internal Iliac are distributed to the pelvic viscera and parietes of this cavity; also to the organs of generation and to the thigh. 1. The *Glutæal* artery is the largest branch, and arises from the back part of the trunk deeply in the pelvis: it passes downwards and backwards through the great sciatic foramen between the bone and upper edge of the pyriform muscle, accompanied by its vein and the superior glutæal nerve; and under cover of the great glutæal muscle divides into a superficial and deep set of branches. Within the pelvis this artery is crossed by the lumbo-sacral nerve. 1. The course of the superficial branch of the glutæal artery is upwards and outwards between the glutæus medius and maximus muscles, in which its branches are partly distributed the integuments of the sacral and glutæal regions receiving their supply from the same source; and branches anastomose with those of the sciatic and pudic arteries. 2. The deep branch is the larger, and directs itself upwards and forwards between the glutæus medius and minimus muscles: it supplies the nutritious artery to the ilium, and then subdivides into a superior set, which take an arched course towards the anterior superior spine of the ilium, following the circumference of the smallest glutæal muscle: the middle set take a direction towards the great trochanter: the inferior branch penetrates the glutæus minimus, and runs forwards above the capsule of the hip-joint to the anterior inferior spine of the ilium: the various muscles in this region and the capsule of the hip-joint are thus supplied; and the several branches communicate with the ilio-lumbar and circumflex arteries of the ilium and thigh. 3. The *Ischiatic* artery is somewhat smaller than the last, and takes a longer course within the pelvis before its exit. It crosses the pyriform muscle and sacral plexus, having the rectum internally: it then leaves the pelvis, in company with the pudic, by the greater sciatic hole, below the pyriform muscle, and makes its appearance in the interval between the great trochanter and tuberosity of the ischium, inclining in its descent to the inner side of the great sciatic nerve. After giving off some insignificant muscular and visceral branches within the pelvis, this artery divides into a coccygeal branch, which is directed inwards, and, after piercing the sacro-sciatic ligaments, is distributed to the neighbouring muscles, anastomosing with the sacral arteries. The muscular branches are considerable, and are distributed to the glutæal and posterior femoral regions, anastomosing with the circumflex and perforating arteries of the thigh. Lastly, the accompanying artery of the great sciatic nerve is derived from the ischiatic: it penetrates the nerve at variable distances down the thigh, and supplies it in its course and distribution. 4. The *Obturator* artery is very irregular in its origin, sometimes arising from the external iliac, but more frequently from its epigastric branch. When arising from the internal iliac, it comes from its anterior part, and takes a direction forwards and downwards to the upper part of the thyroid foramen: in this course it lies inferior but parallel to the external iliac vessels, and has its accompanying vein beneath it, and the obturator nerve above it. On entering the femoral region it lies between the pectinæus and obturator externus muscles, where it divides into its ultimate branches. The obturator artery gives off small twigs to the surrounding parts within the pelvis, and in the thigh divides into an anterior branch, which descends between the adductor longus and brevis muscles, and is distributed to this region, communicating principally with the internal circumflex artery; and a posterior branch which passes backwards and outwards between the obturator muscles and along the outer border of the obturator hole: the muscles about the hip-joint are thus in part supplied, and one or two branches enter the acetabulum at its notch, which are distributed to its contents, and likewise supply the head of the femur. 5. The *Pudic* artery arises from the internal iliac, close to, or in common with, the ischiatic, which vessel it accompanies out of the pelvis, lying internal and anterior to it, but otherwise having precisely the same relations. Immediately after their exit, the pudic artery winds round the spine of the ischium, and again enters the pelvis by the smaller ischiatic foramen: it subsequently ascends in an arched manner along the inside of the tuberosity and ramus of the ischium and ramus of the pubes to the under part

of the Symphysis, where it divides into its terminating branches. In this course the artery lies in a groove formed by the attachment of the obturator fascia to the rami of the ischium and pubes, and at first has the internal obturator muscle between it and the bone. In its first division within the pelvis, and whilst on the spine of the ischium, the obturator artery gives off small visceral and muscular twigs; but its first branches of any importance are the external hæmorrhoidal, which pierce the obturator fascia, and are distributed to the extremity of the rectum, where they communicate with the other hæmorrhoidal arteries. The perineal branch arises next to the last described, and also pierces the obturator fascia close to the triangular ligament, by which means it gains the perineum: it crosses, superficial to the transverse perineal muscle, to the interval between the erector penis and accelerator urinæ, and in company with the nerve of the same name. This artery supplies the perineal muscles, and is ultimately lost in the component textures of the scrotum, where it anastomoses with twigs from the external pudic and spermatic arteries and from the femoral. In the female this branch is large, and supplies the labium. The transverse perineal branch frequently arises from the last, or from the pudic immediately after it: its course is transversely inwards between the bulb of the urethra and anus, and superficial to the transverse muscle; and it supplies the muscles, communicating with its fellow. The artery of the bulb is more considerable and important: it runs in the structure of the triangular ligament a quarter of an inch above its base, towards the bulb, where it divides into a small branch which supplies Cowper's gland, and a large one which penetrates the bulb, and is distributed to the spongy portion of the urethra. The pudic artery itself now pierces the triangular ligament close to the crus penis, immediately prior to its division into its ultimate branches. Of these the artery of the corpus cavernosum enters the crus, and distributes its branches to the cavernous body of the penis, communicating through the pectiniform septum with its fellow. The dorsal artery of the penis gains the back of the penis by ascending between its crus and the ramus of the pubes close to the symphysis, and then runs forwards close to its fellow in the groove between the crura penis, and under cover of the suspensory ligament and superficial fascia: at the corona glandis a free circular anastomosis takes place between the arteries of either side, and branches proceed to supply the glans and prepuce, and communicate with the ultimate twigs of the bulbous artery. A single vein accompanies and lies between the two arteries. The next two arteries supply the interior of the parietes of the pelvis: they are, 6. *The Ilio-lumbar*, which proceeds from the outer and back part of the internal iliac, and directs its course upwards, backwards, and outwards beneath the external iliac vessels and psoas muscle, where it divides: its external or iliac branches penetrate the iliacus muscle, which they supply, and then proceed to the crest of the ilium, where they communicate with twigs of the glutæal and circumflexa ilii arteries: others are lost in the abdominal muscles. The internal or lumbar branches of the ilio-lumbar artery are distributed to the lumbar and iliac muscles, and some twigs enter the lumbar foramina and supply the theca vertebralis: these branches anastomose most freely with the lumbar arteries. The ilium receives its nutritious artery from the iliac branch of the ilio-lumbar. 7. The *Lateral Sacral* artery arises close to (sometimes in common with) the last, from the inner side of the internal iliac: it inclines somewhat inwards as it descends on the anterior part of the sacrum, crossing in its progress the pyriform muscle and sacral plexus of nerves: its branches are distributed to the pelvic viscera and to the pyriform muscle; and the spinal cord receives twigs which penetrate the sacral foramina: it ultimately communicates freely with the middle sacral artery. The remaining branches of the internal iliac are distributed to the viscera, viz., 8. The *middle Hæmorrhoidal*, which supplies the middle portion of the rectum, and communicates freely with the superior and external arteries of this intestine: 9. The *Vesical*, which are irregular in number and origin: one regular branch accompanies the ureter to the inferior fundus of the bladder, and gives off the artery of the vas deferens. Two more branches are superadded in the female, viz., 10. the *Uterine*, which is peculiar from its tortuous nature: it runs to the side of the uterus between the folds of the broad ligament, supplying in its course the Fallopian tubes, ovaries, and vagina; and it ultimately terminates in the structure of the uterus, where its branches anastomose with those of the opposite side. 11. The *Vaginal* artery is distributed to the side of the vagina, and to the neighbouring parts of the other viscera. The last two arteries not infrequently arise from the pudic or some other branch of the internal iliac, instead of coming directly from the trunk.

Arteria Iliaca externa separates from the internal iliac at the sacro-iliac articulation, and descends forwards and outwards to the centre of the crural arch, after passing which it receives the name of femoral. In this course the external iliac artery is at first bound to the inner side of the psoas muscle by a thin layer of fascia, but subsequently it rests on the anterior and inner border of this muscle, having also the iliac fascia behind it: the anterior crural nerve is quite to its outer side, and its corresponding vein is internal and posterior to it above, but on the same plane below: the peritoneum covers the artery and vein. Some small muscular twigs are detached from the external Iliac for the supply of the psoas and iliacus muscles, but its only named branches are two:—1. The *Epigastric* artery arises a little above Poupart's ligament, and at first proceeds downwards, forwards, and inwards to a level with this ligament, and then upwards and inwards between the fascia transversalis and peritoneum to the inner border of the internal ring: in this course it is usually accompanied by two veins, and crosses the external iliac vein. At the internal ring it crosses in front of the vas deferens, which is here hooking round the artery in its progress from the inguinal canal into the abdomen: it then enters the sheath of the rectus, and ascends between it and the muscle, in the structure of which it ultimately terminates by anastomosing with the internal mammary and lower intercostal arteries. The branches of the epigastric are two or three spermatic to the coverings of the cord: others supply the integuments, muscles, and peritoneum: some cross twigs anastomose with those from the opposite side. 2. The *Circumflexa ilii* arises opposite to, or a little lower than, the last branch, and from the fore and outer part of the external Iliac artery. It first runs upwards and outwards to the anterior superior spine of the ilium, corresponding in its course to the line of junction of

the transverse and iliac fasciæ: it then divides, and one branch is distributed to the abdominal muscles, whereas the other continues its course along the inner border of the crest of the ilium, giving off numerous twigs to the abdominal and iliac muscles, and ultimately anastomosing with the ilio-lumbar artery.

Arteria Femoralis.—This large vessel is the continuation of the external iliac through the upper two-thirds of the thigh. It commences at the crural arch, and takes a spiral direction from the anterior to the inner side of the limb, and lastly gains its posterior aspect under the title of popliteal artery. In this course the femoral artery is at first superficially placed, so as to be felt pulsating at the groin, but afterwards it has deeper relations. It lies in its progress through the upper third of the thigh upon the psoas magnus muscle, and then anterior to, but not in contact with, the pectinæus and adductor brevis at their insertions; its own vein and the profunda vessels are here behind the artery: in the middle third it rests on the adductor longus. Above, the artery is covered by the integuments and fascia only, and has its vein to its inner side: the latter vessel soon inclines to the posterior aspect of the former. In the middle third of the thigh the artery lies behind the sartorius muscle and its sheath, having the adductor longus on its inner, and the vastus internus on its outer side: and lastly, it enters the tendinous canal formed by the dense fibrous connexion of these two muscles and the adductor magnus. The anterior crural nerve is separated from the artery above by some fibres of the psoas muscle: a long branch (the saphenus) accompanies the femoral artery, lying on its outer side; and others descend superficial to it. The first branches of the femoral are small but pretty regular: they are three in number, and emerge at the saphenic opening in the fascia lata.

1. The *superficial Epigastric* ascends over Poupart's ligament between the laminæ of the superficial fascia towards the umbilicus, and is distributed to the inguinal glands and abdominal integuments. 2. The *superficial Pudic* branch or branches pass to the integuments and cellular covering of the organs of generation above and below the spine of the pubes; the latter twigs anastomose with the perineal artery. 3. The *superficial Circumflexa ilii* runs along Poupart's ligament to the anterior spine of the ilium, and distributes its twigs in this region, communicating with the deep artery of the same name, and cutaneous branches of the glutæal. 4. The *Profunda* branch is the great artery of supply to the thigh: it arises from the outer and back part of the Femoral, about an inch and a half or two inches below Poupart's ligament, and at first crosses to the external aspect of this trunk, and here lies on the conjoined psoas and iliacus muscles: it then passes backwards and inwards across the cruræus and vastus internus, and descends parallel and posterior to the Femoral artery, separated from it by both venæ comites, and lying first upon the insertion of the pectineus and short adductor, and subsequently behind the tendon of the adductor longus, where its terminating branch is found perforating the adductor magnus to supply the hamstring muscles. The branches of the Profunda are the circumflex and perforating. (*a.*) The *external Circumflex* is usually the first branch, and is not infrequently derived directly from the Femoral. It comes off from the bend of the Profunda, and proceeds outwards between the sartorius and rectus muscles in front, and the psoas and iliacus behind, being surrounded by the divisions of the crural nerve: it divides into ascending branches, which are distributed to the tensor vaginæ femoris, sartorius, and smaller glutæal muscles, and which communicate with the circumflexa ilii and glutæal arteries: the middle or proper circumflex branches cross deeply in front of the cruræus, and pierce the vastus externus and tendon of the glutæus maximus, where they are distributed to the rotator muscles and hip-joint, and communicate with the sciatic, glutæal, and internal circumflex arteries. The descending branches are the longest and largest, and take their course behind the rectus and vastus externus, which muscles they supply, and then anastomose with the external articular arteries. (*b.*) The *internal Circumflex* artery arises from the inner and back part of the profunda: it almost immediately crosses the tendon of the psoas and iliacus a little above the smaller trochanter, and then passes between the external obturator muscle above and the short adductor below: it is subsequently interposed between the adjoining margins of the quadratus and adductor magnus, where it is covered by the glutæus maximus. In this course the internal circumflex distributes branches to the adductor mass of muscles, some of which become cutaneous, and others communicate with the obturator. A small branch usually enters the acetabulum, and supplies both surfaces of the articulation. The terminating branches of this artery are an ascending one, which is guided by the external obturator tendon to the trochanteric fossa, where it communicates with the glutæal and external circumflex; and a descending branch, which is distributed to the glutæal, adductor, and hamstring muscles, and communicates with the perforating and ischiatic arteries. (*c.*) The *superior perforating* artery arises from the back of the Profunda, and, passing beneath the lower border of the pectineus, pierces the adductor brevis and magnus, to supply the glutæal and hamstring muscles. (*d.*) The *middle perforating* artery also pierces the great and usually the small adductor, and is similarly distributed: it is generally the largest of the three, and also supplies the vastus externus muscle. (*e.*) The *inferior perforating* artery passes through the adductor magnus opposite the upper border of the long adductor, and supplies the hamstring muscles, and anastomoses with the muscular branches of the popliteal artery. 5. The great *Anastomotic branch* arises from the Femoral just before it enters the popliteal space, and, directing its course to the inner condyle, divides into branches which supply the vastus internus and cruræus muscles, and communicate with the external circumflex and inner articular arteries, where it helps to supply the articulation: this artery is accompanied round the knee by the great saphenus nerve.

Arteria Poplitea.—After penetrating the adductor magnus, as above described, the great artery of the lower limb receives the name of the space through which it passes, and occupies the posterior aspect of the thigh and leg: at the lower border of the popliteus muscle it bifurcates. The course of the popliteal artery is oblique, extending from the inner side of the ham above to its centre below. At first it is covered by the semi membranosus, but soon emerges, and then has only the fascia and integuments superficial to it: inferiorly, however, it is again covered by the converging heads of the gastrocnemius muscle. The anterior relations of the artery are, in succession, the femur, the

ligament of Winslow, and the popliteus muscle. The popliteal vein is posterior to the artery, and a little to its outer side, and the popliteal nerves are still more superficial: of these the inner division crosses to the tibial side of both artery and vein below. The density of the popliteal fascia, and the adipose matter and glands in this region prevent the pulsation of the artery being felt so distinctly as might be anticipated. The following branches are derived from the popliteal artery:—1. *Superior muscular* branches, to the hamstring muscles. 2. *Inferior muscular* branches, to the gastrocnemius and soleus muscles. 3. *Superior internal articular*, which arises beneath the semi-membranosus, and winds above the inner condyle beneath the tendon of the great adductor: it is distributed to the vastus internus and knee-joint, communicating above with the anastomotic artery. 4. *Superior external articular* takes a similar course over the outer condyle of the femur and beneath the biceps tendon; and it has a parallel distribution. 5. *Inferior internal articular* is applied around the neck of the tibia, where it is covered by the inner lateral ligament of the knee-joint, and crossed by the three tendons which are here passing to their insertion: its distribution is to the joint. 6. *Inferior external articular* runs under cover of the outer head of the gastrocnemius, the plantaris, and external lateral ligament; it is subsequently applied upon the convex border of the outer semilunar cartilage, along which it runs to the patella: it is here distributed upwards and downwards, the lower twigs anastomosing with the recurrent tibial. 7. The *middle articular artery* pierces Winslow's ligament, and ramifies in the interior of the articulation. All these articular branches communicate more or less with each other around and in the knee-joint.

Arteria Tibialis antica.—This is the smaller of the two branches which result from the bifurcation of the popliteal trunk; and immediately after its separation it passes through the interosseous space close to the neck of the fibula, in which course it penetrates some fibres of the posterior tibial muscle, and is accompanied by a small nerve. In the anterior tibial region this artery is first found lying between the tibialis anticus and extensor digitorum; then between the former and extensor pollicis; and in the inferior third of the limb, between the last named (which overlaps it) and the common extensor of the toes. The artery is deeply seated above, being covered in by the muscles on either side of it, and resting on the interosseous ligament; but in the lower part of the limb it is more superficial, and rests on the anterior part of the tibia. On leaving the tibial region, the anterior tibial artery crosses beneath the annular ligament to the tarsus, lying in succession on the astragalus, navicular, and inner cuneiform bones, and having superficial to it the inner tendon of the short extensor; at the first interosseal space of the metatarsus the artery ultimately bifurcates. The venæ comites lie one on either side of the artery, and the anterior tibial nerve is superficial, and generally on its outer side.

The branches of the anterior tibial artery are—1. The *Recurrent*, which arises just after the artery has passed the interosseous space, and, after piercing the tibialis anticus, is distributed to the anterior and outer part of the knee-joint, communicating with the inferior articular branches. 2. The *muscular* branches arise at various points, and are distributed to the muscles in this region. 3. The *internal malleolar* branch arises a little above the base of the tibia, and, crossing beneath the tendon of the tibialis anticus, is distributed to the region whence it is named. 4. The *external malleolar* branch is larger, and, passing beneath the tendons of the common extensor and that of the great toe, supplies the outer malleolar region. 5. The *tarsal* branch passes outwards beneath the tendons on the dorsum of the foot, and is distributed to the short extensor muscle and tarsal articulations. 6. The *metatarsal* branch takes an arched course across the bases of the metatarsal bones, supplying them, and sending twigs forwards to the outer three interosseal spaces: these anastomose with the plantar arteries, and supply the dorsal interossei muscles. The terminating branches are (7.), the *dorsal* artery of the great toe, which divides and supplies the tibial side of the great toe, and opposed margins of the first and second toes; and (8.) the *communicating* branch, which descends through the first metatarsal interosseous space to join the termination of the external plantar artery.

Arteria Tibialis postica descends from the popliteus muscle, through the posterior tibial region, and between the superficial and deep layer of muscles, to the depression between the inner malleolus and heel, where it bifurcates. Through its whole course this artery is covered by the deep fascia of the leg, which, in fact, forms its only investment (in addition to the superficial fascia) in its inferior third, where the muscles leave it otherwise exposed. In its upper third it rests on the tibialis posticus, in its middle third on the flexor digitorum, and lower down some cellular tissue alone separates it from the tibia; two venæ comites accompany the artery; and the posterior tibial nerve is usually external to it through the greater part of its course. At the ankle the above relation holds good, and the parts enumerated lie between the flexor digitorum anteriorly, and flexor pollicis posteriorly. The following are the branches of the posterior tibial:—1. *Muscular*, to the superficial and deep layers of muscles. 2. The *nutritious* artery, which enters by the foramen in the tibia for that purpose, and is distributed to its interior. 3. The *peroneal* artery arises from the posterior tibial about an inch below the popliteus muscle: it soon inclines outwards, and, piercing the tibialis posticus muscle, descends on the interosseous ligament close to the fibula, under cover of the flexor pollicis. In this course many muscular branches are detached, especially for the supply of the flexor pollicis and peronei: a considerable branch usually crosses transversely between the peroneal and posterior tibial arteries in the lower part of the leg. The terminating branches of the former are,—an anterior, which pierces the interosseous ligament a littlae bove the ankle-joint, and on the back of the fibula anastomoses with the external malleolar artery; and a posterior branch, which descends behind the outer malleolus, and supplies the neighbouring muscles and the joint, communicating with the tarsal, metatarsal, and external plantar arteries. 4 and 5, the *plantar* arteries, are internal and external. Of these the former is much the smaller, and more simple in its distribution: it runs along the inner side of the sole of the foot, under cover of the abductor pollicis, giving off branches to supply the muscles of the great toe, and to anastomose with others from the anterior tibial; its ultimate branches are distributed to the integuments of the great toe. The external Plantar artery takes a long and flexuous course before it terminates at the base of the metatarsal bone of the great toe by junction with the

anterior tibial. Its direction is first outwards and forwards towards the base of the metatarsal bone of the little toe, during which it lies between the flexor tendons and accessorius muscle above, and the short flexor of the toes and plantar fascia below: from this point it proceeds forwards a short distance (its most superficial position), and then extends across the metatarsal bones in the grooved interval between the transversalis pedis and adductor pollicis, lying above the long flexor tendons and lumbricales: the convexity of the arch thus formed is directed forwards and outwards. In the earlier part of its course the external plantar artery distributes twigs to the various adjoining muscles; but in its second division (properly called the *plantar arch*) the most important branches arise; they are the perforating and digital. Of these, the former supply the interossei, and communicate with the metatarsal branches of the anterior tibial; and the latter, which are four in number, supply severally the fibular side of the little toe, the opposed margins of the fourth and fifth, of the third and fourth, and of the second and third toes; in which distribution they are accompanied by the divisions of the plantar nerves, and they anastomose at the extremities of the phalanges. The opposed borders of the first and second toes are supplied, as already described, by the anterior tibial artery.

Venous System (*das Venensystem*, Germ.; *le Système Veineux*, Fr.).

The blood from the various parts of the body (with the exception of the lungs) is ultimately collected into two large Veins, which are severally named the Vena Cava superior and Vena Cava inferior; and these both terminate in the right auricle of the heart. A particular description of the greater part of the venous branches which constitute these great trunks is superfluous, inasmuch as they for the most part accompany the corresponding arteries; there are, however, many superficial veins superadded which are unrelated altogether to the ramifications of the arterial system.

The veins which collect the blood from the head and neck are the *superficial* and *deep Jugular*. The superficial or *external Jugular* vein is formed by the junction of the temporal and internal maxillary veins, which takes place in the parotid gland; it thence passes downwards and backwards, crossing obliquely the sterno-mastoid muscle, but being almost parallel to the fibres of the platysma, by which it is covered, and ultimately joins the subclavian vein. In its progress through the neck, the superficial Jugular receives a branch from the facial, and the posterior auricular and cutaneous cervical veins; and usually communicates by one or more twigs with the internal Jugular. The deep or *internal Jugular* vein commences at the posterior lacerated foramen of the Skull, where the lateral sinus terminates:* it descends posterior and external to the Carotid artery, from which it is separated by the pneumogastric nerve, and terminates opposite the sternal extremity of the clavicle by joining the subclavian at a right angle. In its progress down the neck, the internal Jugular receives in succession the facial, lingual, pharyngeal, superior thyroid, and occipital veins; also the middle thyroid branches, and some small cutaneous veins from the neck. The veins of the diploë of the Skull terminate in the lateral sinuses, and in the frontal, deep temporal, and occipital veins.

* For the description of the sinuses, see 'Nervous System—Brain.' 437.

The Veins of the upper extremity are superficial and deep: of the former there are three. The *Cephalic* vein is first formed by radicle branches, which collect the blood from the outer and back part of the hand: it then ascends on the outer and anterior part of the fore arm, and opposite the elbow-joint is joined by the median cephalic: it thence proceeds in a vertical direction, on the outer and fore part of the upper arm, to the interval between the deltoid and great pectoral muscles, and ultimately sinks beneath the clavicle to join the axillary vein just before it becomes subclavian. The *Basilic* vein commences by a considerable branch (vena Salvatella) on the back of the last two metacarpal bones: it ascends along the ulnar side of the fore arm, and at the elbow is joined by the median basilic branch, and then continues its course along the inner side of the upper arm, receiving twigs and anastomosing with the cephalic in its progress. The Basilic is the largest vein of the arm, and ultimately becomes continuous with the axillary. The *Median* vein commences at the anterior part of the carpus, and terminates by division into the two branches already mentioned, and usually a third, which joins the deep veins. The *venæ comites* of the arteries are two in number to each: the brachial veins ultimately join the basilic to form the *Axillary* vein, which ascends in front of the artery to the subclavian space, receiving in its progress the circumflex, subscapular, and thoracic branches. The *Subclavian* vein is placed anterior and somewhat inferior to the corresponding artery, from which it is separated by the scalenus anticus muscle, the pneumogastric and phrenic nerves. The union of the subclavian and internal jugular veins of either side constitutes the *Venæ Innominatæ*. Of these veins the left is longer and more horizontal in its course, and usually larger than the right. The subclavian veins receive the vertebral, external jugular, and superior intercostal veins; the left bronchial vein terminating in the left superior intercostal, and the deep cervical joining the vertebral. In addition to the above, the subclavian of the left side receives the corresponding internal mammary and inferior thyroid veins; which branches on the right side terminate in the superior cava. The long vena innominata of the left side crosses the trachea and origin of the arteries from the arch of the aorta to a point opposite the cartilage of the right first rib, where it joins the corresponding shorter vein of the right side to form the—

Vena Cava superior vel descendens.—This great trunk descends, inclining a little forwards and to the left side, in front of the right pulmonary vessels, and enters the pericardium, the fibrous portion of which is prolonged on its surface. Within the pericardium it is surrounded by the serous membrane, and lies to the right of the aorta: it terminates in the posterior and upper part of the right auricle of the heart. Besides the two branches already noticed, the vena cava superior receives the *Vena Azygos*, just as it is entering the pericardium. This vein commences in the lumbar region just below the diaphragm, and, passing through the aortic opening of that muscle, continues its course through the posterior mediastinum to the right of the aorta and thoracic duct, and in front of the right intercostal arteries. In this course it receives the right intercostal and bronchial veins, and branches from the œsophagus: and lastly, a similar vein from the left side (azygos minor) crosses the spine about the fifth dorsal

vertebra to join it. The vena azygos then arches forwards around the root of the right lung and opposite the fourth dorsal vertebra, to terminate in the back part of the vena cava, as above described.

The superficial veins of the lower extremity are the *External* and *Internal Saphena*. The former of these ascends from the back and outer part of the foot, behind the external malleolus and superficial to the fascia, to the popliteal space, where it dips in between the heads of the gastrocnemius to join the popliteal vein. The internal saphena commences by radicles from the dorsum of the inner toes, and after communicating with the external ascends as a single trunk in front of the inner malleolus, and thence proceeds superficial to the fascia along the inner side of the leg, posterior to the inner condyle at the knee-joint, and subsequently along the inner and fore part of the thigh to the saphenic or falciform opening in the fascia lata, where it joins the femoral vein: in this progress it is joined by several smaller and one or two large branches, by which it is materially augmented in size; and in the thigh it is parallel, but on a plane a little internal, to the femoral artery.

The *Venæ comites* of the *tibial* and *peroneal* arteries (two to each) unite to form the *popliteal* vein, which lies superficial to the artery, inclining to its inner side below and to its outer side above. This large vein then accompanies the artery through the opening in the adductor magnus, and in the *femoral* region lies first on its posterior aspect and subsequently quite to its inner side. At the crural arch the femoral vein is interposed between the artery and crural ring. Each *external Iliac* vein lies to the inner and posterior part of the corresponding artery, and at the sacro-iliac articulation joins the *internal Iliac* to form the *common Iliac* vein. Of this large pair of vessels the left is the longer, and though on a plane posterior to the common iliac-artery of the same side, it lies almost entirely internal to it: the right vein is behind the corresponding artery, by which latter vessel the angular unión of the two common Iliac veins is concealed.

The *Vena Cava inferior vel ascendens* is of larger calibre than the superior, and extends from the fourth or fifth lumbar vertebra to the heart. In its progress through the abdomen it lies on the bodies of the vertebræ, to the right of the median line and of the aorta, and in front of the right psoas muscle and crus of the diaphragm, as well as of the right renal artery and capsule: the peritoneum and small intestines lie anterior to it, and the perpendicular division of the duodenum is in direct contact with its anterior surface. Having arrived at the liver, it passes through a groove (sometimes a canal) between the right and Spigelian lobes, then penetrates the tendinous portion of the diaphragm and contiguous part of the pericardium, and terminates in the lower and back part of the right auricle. In this course it receives in succession the middle sacral vein, the four pair of lumbar veins, the right spermatic, the renal, the supra-renal, the hepatic, and phrenic veins. Of these, three only will require a separate notice. The *Spermatic* veins differ in their origin in the male and female, as the arteries differ in their distribution; and that of the left side terminates in the corresponding renal vein. Of the renal or emulgent veins the left is the longer, and crosses the aorta superficially: each commences by several large branches, which leave the kidney usually anterior and superior to the arteries and ureter. The *Hepatic* veins collect the blood from the right, left, and Spigelian lobes of the liver, and terminate in the vena Cava just before it pierces the diaphragm.

The *Vertebral* canal presents *Sinuses* similar in character to those of the skull (with which they have no communication), and which extend from the occipital foramen to the extremity of the sacrum, between the theca vertebralis and bodies of the vertebræ, lying on either side of the posterior common ligament: they anastomose by transverse branches with each other; and further communicate with the internal jugular, vertebral, intercostal, and lumbar veins: they receive small veins from the cancellated structure of the vertebræ and from the dura mater of the canal. The *Spinal* veins accompany the arteries of the cord, and terminate in the inferior cerebellar veins.

The *great Coronary* vein ascends from the apex of the heart along the anterior fissure, in company with a branch of the right coronary artery, from which it separates at the base of the ventricles, and takes a direction to the left side, and proceeds along the groove between the left ventricle and auricle: in its progress it collects the blood from the different cavities of the heart, and is a good deal dilated just before it opens into the posterior and inferior part of the right auricle. Other and smaller cardiac veins open separately into the right auricle; but they are not sufficiently important or regular to deserve a particular description.

The *Vena Portæ* collects the blood from all the chylopoietic viscera, and conveys it to the liver. The two large trunks which by their convergence form the vena portæ are the following:—The *Splenic* vein commences by six or eight branches in the spleen; these unite to form a single trunk which accompanies the corresponding artery (beneath which it lies) along the posterior aspect of the pancreas to its right extremity; in this course it receives the *cardiac*, *gastro-epiploic*, and *coronary* veins of the stomach; the *duodenal*, *pancreatic*, and (usually) the *inferior mesenteric* veins. The *superior Mesenteric* vein corresponds to the artery of the same name in its course and distribution: it ultimately joins the splenic vein at a right angle behind the right extremity of the pancreas. The trunk of the portal vein results from this union: its length is about four inches, and it extends upwards and to the right side beneath the middle portion of the duodenum, and in front of the aorta: it then insinuates itself between the layers of the lesser omentum, lying behind and between the hepatic artery and duct, and receiving small branches from the omentum and gall-bladder. At the transverse fissure of the liver, the vena portæ divides into right and left branches, which accompany the corresponding arteries into either lobe of this organ, and receive in common with them an investment from the capsule of Glisson. Of this division the left branch is the longer and smaller: it supplies the Spigelian lobe, and runs horizontally as far as the obliterated umbilical vein before it enters the left lobe of the liver.

Capillary System (*Die Haargefässe*, Germ.; *le Système Capillaire*, Fr.)

The anatomy of this system is comprised in but few words. The vessels which constitute it are presumed to exist in every part of the body: they are of equal diameter throughout: they communicate freely and frequently with each other; and they are probably

invariably interposed between the extreme branches of the arteries and ultimate radicles of the veins.

Structure and Functions of the Blood-vessels.—The offices of the three divisions of the circulating system of vessels, the anatomy of which has been just considered, may be simply summed up under the following heads:—The *Arteries* are the conduits which convey the blood to all parts of the system; the *Capillaries* receive this blood, and through and by them the various processes which in the aggregate constitute Assimilation are accomplished; the *Veins* receive the blood from the capillaries, and convey it back to the heart, for it to undergo purification in the lungs. It is apparent, therefore, that however insignificant this middle system may be in an anatomical or surgical point of view, it is of far higher interest and importance as associated with physiology than either the arterial or venous systems.

The characteristics of an *Artery* are, that it is a cylindrical tube of a yellowish colour, and possessing a considerable amount of elasticity. The arteries nearest to the heart are the largest and also the thickest: the Pulmonary artery is less dense than the Aorta. The importance of these vessels requires that every care should be taken of them in their progress to their destination: the large trunks are accordingly found imbedded in muscles, or situated in the concavity of joints, and on the inside of the limbs. The primary branches and their offsets are separated at different angles, which are determined generally according to the distance of the parts to be supplied: the force of the circulation is thus in a measure equalized. The inosculation between arteries takes place in three different ways,—either in the form of an arch, by straight branches, or by the union of two into one: these communications are of great importance to the preservation of the integrity of the circulation in case of interruption from any obstruction: the arterial circle in the brain illustrates the above point. Arteries are tortuous for various purposes: thus the dilatation of organs, such as the uterus, bladder, lips, and cheeks is permitted: but there are probably other and more important ends attained by this arrangement, which will be presently noticed. The amount of arterial supply to different structures is proportioned to their importance and peculiar functions; thus the brain, glands, and all secreting organs, growing parts, &c., are highly organized, whilst in some textures, such as cartilage and tendon, few or no vessels can be traced. Arteries possess three *Coats*,—an external or cellular, a middle or proper elastic coat, and an internal or serous lining. The first of these consists of a compact layer of oblique fibres, pale and firm, and closely interwoven: the middle tunic is composed of fibres placed transversely in relation to the length of the vessel, and each forming an incomplete segment of a circle; in the larger arteries this is highly elastic:* on the contrary, the internal coat is inelastic and brittle, being a continuous membrane without fibres, which is dense and semi-transparent. The arteries receive their own supply of blood usually through offsets from muscular branches; and the nervous supply is derived from the sympathetic system.

The structure of the *Veins* constitutes a remarkable contrast to that of the arteries, and indicates that they are little else than passive tubes, along which the blood passes in its progress from all parts of the system to the heart. They have but two coats, which correspond with the outer and inner tunics of arteries;* hence they are thinner and less elastic, but they are also tougher and more distensible than those vessels. The external coat is further absent in some parts, as in the sinuses of the brain, and in bones. One remarkable peculiarity in veins is the existence of valves, the use of which is to prevent the retrograde course of the blood, especially under muscular compression: they consist of a reduplication of the lining membrane, with a thin layer of intervening tendinous structure. These valves are not, however, universally present, but are wanting in the cerebral, pulmonary, internal jugular and portal veins; neither are they found in either of the two great venous trunks, nor in any the diameter of which is less than a line: they are more needed and therefore more numerous where the blood moves against gravity, and are relatively more frequent in the superficial than the deep veins. These valves, which in construction and action are precisely similar to the semilunar valves of the aorta, consist generally of two folds, placed opposite to each other, with their free edges towards the heart; but sometimes there is only one fold, or there may be three, or even four. The capacity of the venous system greatly exceeds that of the arterial, there being often two veins to one artery, independently of the superaddition of the superficial veins. The inosculations in the venous system are more frequent than in the arterial,—a point which is rendered essential by their superficial position and thinness, which renders them more ob noxious to compression: exercise, however, is necessary to facilitate the healthy circulation through the veins, which is not effected, as in the arteries, by jets, but the blood flows evenly and uninterruptedly through them.

The *Capillaries* are now justly regarded as an independent set of vessels, forming the connecting link between the arteries and veins. They are the vessels by which the actual processes of secretion, growth, and reproduction are carried on: they are of nearly equal calibre throughout, and anastomose very freely; and the blood moves through them slowly and evenly. Dr. Wedemeyer has suggested that the capillary circulation is not conducted by means of actual vessels, but that the arteries terminate in canals, which are, as it were, worn in the substance of the different tissues.

There is much temptation for speculation in discussing how the circulation through the different sets of vessels is performed; and physiologists are by no means agreed as to the extent or even nature of the forces which are called into operation. One point is clear, that the impulse of the circulation is in a great degree attributable to the direct action of the heart, for the jet of blood is synchronous with the contraction of the ventricles. Moreover, we can probably form but an imperfect estimate of the facility with which the blood circulates, by its appearance after removal from the vessels: its then viscidity may be incompatible with life and circulation; and it is more than probable that the vitality of the blood and vessels exercise a mutual influence on each other. Indeed, Sir Charles Bell† ingeniously suggests that the universal attraction between

* For further particulars, see 'Vascular Tissue,' and 'Elastic Tissue,' p. 253.

* The large veins near the heart offer an exception to this rule: here thin irregular fibres are interposed between the two coats, which probably only augment the strength and resistance of the vessels in this position.

† In his pamphlet, *On the Forces which Circulate the Blood.*

solids and fluids is suspended in the vessels of a living body, and resumed on the occurrence of injury or death; and thus vast resistance is overcome by annihilation instead of accumulation of force, which is more consistent with the delicate texture of our frames. But is the heart's action alone sufficient (without *active* assistance from the arteries) to propel the blood into the capillaries? Opposite opinions have been espoused by different physiologists respecting this point. Mr. Hunter, who advocated the muscularity of arteries, performed several experiments to illustrate the subject: he divided a large artery, and found the stream of blood gradually cease as the artery contracted: and in another instance he bled a horse to death to procure as much contraction of the arteries as possible, and after death he removed a portion of the aorta, which he slit up and measured: after forcibly stretching it in its breadth, he found that it did not contract to its former dimensions. Sir G. Bell's observations* on tortuous arteries also bear importantly on the subject. He observes that those arteries which carry blood downwards have less curvature than those which carry it against gravity. Again, arteries going to growing tumors are tortuous, as are also those of the active mamma, and of the uterus during gestation. In establishing collateral circulation, arteries become tortuous as well as enlarged, which is not the case in those of an amputated limb. The evidences of partial excitement in the vascular system may be explained by assigning to arteries the property of exercising an independent action. The conclusions which Sir C. Bell labours to establish from the above facts are these: if arteries be muscular, those which are tortuous must of course possess more muscular fibres than those which are straight, and be more independent of the heart's action: further, this tortuosity increasing as they recede from the heart, they of course become more directly identified with, and under the control of, the organ they supply; and so, when not excited, a tortuous artery may retard, and when stimulated it may accelerate, the flow of blood. This hypothesis seems to be countenanced by the anatomical fact that organs, the activity of which is occasional or remitted (as the uterus, testicle, and spleen), possess tortuous arteries: and it may be added, that arteries almost uniformly become more flexuous as they approach their destination. On the other side, it may be remarked that the middle coat of an artery (the only possible seat of active contractility) possesses neither the physical nor chemical characters of muscular fibre: it is very elastic and destitute of fibrin. The property of contracting after extension is possessed by arteries after death; and no action is produced by the agency of mechanical stimuli or galvanism: but it must be remembered that muscular contractility does not survive (except for a limited period) the life of a part. Probably the true solution of this problem is after all to be found in ascribing elastic properties alone to the arteries near the heart; whilst to those of small calibre, which are removed to a distance from its influence, an amount of muscularity may be conceded, which may be supposed to bear a direct proportion to the extension of the circle in which they are found. In returning the blood to the heart through the veins, several causes appear to operate concurrently: these are, the influence of the heart and arteries constituting a "vis a tergo;" the tendency to a vacuum in the chest, aided probably by external atmospheric pressure, during inspiration; the heart's sorbent power, as apparently proved by experiment. In assigning to each of these causes their due influence, the important fact must not be lost sight of, that the valves in the veins prevent any reflux of the blood;—a point which is further illustrated by the agency of muscular compression in accelerating the venous circulation. It has been observed that during contraction of the auricles the great veins fill, and during dilatation that the distension is diminished: certainly the latter condition may be remarked at each inspiration in the cerebral sinuses when the skull is laid open. The circulation through the capillaries is uniformly regular and even, when undisturbed by any exciting cause: in them probably the partially expended force which drives the blood through the arteries on the one hand, and the new forces brought into operation in the venous circulation on the other, jointly concur in producing this effect.

The *Pulse* may be defined as that impulse which is produced in elastic cylinders by the active contraction of a muscular organ,—in fact, such apparatus as is presented by the heart and arteries in the relation they hold to each other: this impulse immediately succeeds the contraction of the left ventricle, although the interval is so trifling as to be imperceptible in arteries near the heart. The impression of dilatation which is conveyed to the finger when placed on a beating artery is erroneous, at any rate in degree; for experiment has proved that the calibre of an arterial trunk is augmented to a very inappreciable extent; but these vessels are very elastic longitudinally, and the sensation produced by the pulse is principally attributable to their tendency to extend themselves in this direction. The rapidity of the pulse differs at various periods of life: in new-born infants it is about 140; at the end of the first year, about 120; at the fourth year, 90; at puberty, 80; in manhood, 75; and later in life it becomes slower. It is quicker in small than in large animals; in horses it is about 40, but in a small dog it is difficult to count: it is rather quicker in women than in men. The rapidity of the pulse is increased by stimulants, such as wine, warmth, &c.; but continued cold depresses the heart's action. The varying character of the pulse is dependent on, and indicative of, corresponding conditions and changes in the action of the heart: a knowledge of these is, therefore, of great value to the medical practitioner. It has been calculated that the whole mass of the blood in an adult exceeds thirty pounds, which occupies between two and three minutes in its passage through the heart.

* *Op. Cit.*

SECTION VII.

ORGANS OF RESPIRATION.

UNDER the above head are to be included the air-tube, consisting of the larynx, trachea and bronchi, and the lungs: but as a particular description of the larynx has been already given,* a brief recapitulation of its anatomy is all that will be necessary in the present section. The form, development, and organization of this division of the *air-tube* characterize it as designed to fulfil the two-fold function of an organ of respiration and voice. It consists of an expanded cartilage (the thyroid), the two plates of which are united at an angle in front, but widely separated behind: below this is an annular cartilage (the cricoid), which is broad behind and narrow anteriorly. This again is surmounted by a pair of moveable cartilages (the arytenoid), which are bound by strong elastic ligaments (chordæ vocales) to the posterior angular portion of the thyroid cartilage. Strong elastic membranes further connect the thyroid and cricoid cartilages in front, and the latter to the first ring of the trachea; and a further development of similar tissue unites the thyroid cartilage and os hyoides, which in its turn is attached by round ligaments to the styloid processes of the temporal bones. The epiglottis surmounts the glottis or upper orifice of the larynx, and is connected partly by fibrous tissue, but principally by reflections of the mucous membrane, to the notch in the upper edge of the thyroid cartilage, to the os hyoides and base of the tongue, and to the arytenoid cartilages. An appropriate muscular apparatus performs the various motions of elevation and depression of the larynx, as well as of contraction and dilatation of the rima glottidis, and modification of the tension of the chordæ vocales. The anterior and lateral parts of the larynx are embraced by a body of a soft and spongy character, and reddish-brown colour, known under the title of *Thyroid gland*: it is convex in front, and consists of two oval lobes, connected anteriorly by a transverse band, which lie on the lower part of the larynx and upper rings of the trachea; posteriorly and laterally it is in connexion with the carotid sheath and its contents. This organ varies much in dimensions: it has no duct, and its title to be called a gland is more than questionable: its function is not understood. The *Trachea* extends from the larynx to the bronchi, and consists of a series of fibro-cartilages (about eighteen or twenty in number), which, though annular in form, are incomplete, each constituting about three-fourths of a circle, the posterior fourth being occupied by a fibrous membrane, which is continued around, and in the interval between, the tracheal rings. The fibro-cartilages are flattened, and vary in their diameter; but the calibre of the tube itself is the same throughout. The outer membrane is studded with glands, which open by small ducts upon the surface of the mucous membrane: this latter is continuous with the lining membrane of the mouth, and extends through all the ramifications of the bronchi. The following are the relations of the trachea to surrounding parts: it is partially covered in the neck by the thyroid body, the sterno-hyoid and thyroid muscles, and the inferior thyroid veins: in the chest it lies posterior to the arch of the aorta, the arteria innominata and left vena innominata: its membranous portion rests upon the œsophagus; and it has on either side of it the carotid sheath and its contents. Opposite the second or third dorsal vertebra, the trachea divides into the right and left bronchus. Of these the right is larger and shorter, and its course is more horizontal than that of the left: the former is related to the curve of the vena azygos, and the latter passes obliquely downwards, and to the left side through the arch of the aorta to the left lung. Each bronchial tube divides, and the lower division of that destined for the right lung gives off a branch to its middle lobe. This binary arrangement is continued through five or six subdivisions, until ultimately the tubes diminish to capillary dimensions, and terminate in the air-vesicles. The bronchi and their earlier ramifications are similarly constituted to the trachea.

Anatomy.

The *Lungs* occupy the lateral divisions of the thorax, and correspond in form to the containing cavity; that is, they are conical, with their base below and apex above. The varying dimensions of the thorax being constantly accompanied by proportionate distension of the lungs, it necessarily follows that these organs at all times accurately fill the chest: they are surrounded by a serous membrane to be presently described, and are separated by the heart, which occupies the middle mediastinum. The colour of the Lungs varies at different periods of life, and under different circumstances: in the adult they are of a bluish-grey tint, and mottled with darker patches, which latter are more apparent later in life: in the young the tint is of a brighter and more pink character. These organs are not symmetrical, the points of difference being attributable to the position of the liver on the right side, and the inclination of the heart to the left. Externally the Lungs are convex, and internally slightly concave, where they correspond to the pericardium: their anterior margin is sharp, and notched opposite the apex of the heart on the left side; but their posterior margin is obtuse and rounded, corresponding to the furrow on each side of the spine: their base is slightly concave, and rests on the convexity of the diaphragm; and their summit is obtuse but narrow, and rises a little above the level of the first rib. Each Lung is divided by a deep fissure into two lobes: it descends from behind the summit of the organ obliquely downwards and forwards, and ends in front of the base; by which

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* See 'Muscular System,' p. 414.

arrangement the superior lobe is also the anterior of the two. The following are the points of contrast between the two Lungs:—the right is shorter but broader than the left, and generally rises a little higher in the neck: it is further subdivided by the presence of a second fissure, which extends from the great one forwards and downwards, and thus cuts off a middle lobe from the superior: this fissure is comparatively shallow, and the resulting lobe is triangular in form, with its base outwards. The root of each Lung is situated a little above its centre internally, and nearer to its posterior than its anterior aspect: its chief constituents are the bronchus, pulmonary artery, and veins: on both sides the pulmonary veins are placed inferior and anterior to the artery and bronchus, the latter being as regularly posterior to the artery; and the only difference between the two sides being, that on the left the bronchial tube is inferior to the artery, whereas the reverse is the case on the right. In addition to the above, the bronchial arteries and veins, branches of the pulmonary plexus of nerves, and lymphatics constitute a part of the root of each lung. The *Pleuræ* are a pair of serous membranes which invest the lungs, and are reflected on the inner surface of the containing cavity: each is a shut sac, and exhales the usual halitus secreted by serous membranes. In tracing either pleura, it is found to direct itself over the ribs and intercostal muscles to the side of the spine, where it forms the side of the posterior mediastinum: it is thence reflected on the posterior part of the pericardium, from which it passes to the back of the root of the lung, and is by it conducted to the lung itself, which it completely invests, sending down processes into the fissures: from the lung it extends along the upper surface of its root to the side and fore part of the pericardium, to which it adheres, and from which it is reflected to the back of the sternum, forming the lateral boundaries of the anterior mediastinum, and becoming here continuous with the line of reflexion with which the description was commenced. Superiorly, each pleura presents a cul-de-sac corresponding to the summit of the lung; and inferiorly, it is expanded over the thoracic surface of the diaphragm: a separate reflexion from the lower edge of the root of the lung to this muscle is called the broad ligament of the lung.

The *Mediastina* result from the arrangement of the two pleuræ in relation to each other and to the contents of the central division of the chest. The *anterior* mediastinum is immediately behind the sternum, in front of the pericardium, and between the pleuræ: it is narrow in the centre where the serous membranes are most nearly approximated, and expanded above and below: the direction of the pericardium causes a corresponding inclination of this space to the left side below: its contents are the sterno-hyoid and thyroid muscles at their origins, also the triangularis sterni and remains of the thymus gland. The *middle* mediastinum contains the heart and pericardium: and the *posterior*, which has its base at the spine, and is bounded in front by the pericardium, contains the œsophagus, aorta, vena azygos, thoracic duct, and the eighth and splanchnic nerves.

Structure and Physiology of the Organs of Respiration.

As the lungs possess all the ordinary constituents, and perform the usual functions of secreting organs, they may be fairly placed in the same category with true glands: their secretion is carbonic acid, and their common duct the trachea. In examining the structure of the air-tubes, both trachea and bronchi, a tissue closely allied to the muscular is perceptible: this, according to the investigations of recent inquirers, and from late experiments, appears to be actual muscle, though belonging to the unstriped variety; and it may be traced through the bronchial ramifications "as far as the air-cells themselves, though not into them:" it is further asserted that these fibres may be excited to contraction by the galvanic stimulus.* As the bronchial ramifications diminish in calibre, their rings gradually lose their annular form, and degenerate into irregular lamellæ dispersed over the canal: but still there is perceptible a peculiar elaboration, which retains the annular form at the different points of division, by which the tube is strengthened and kept from collapsing. These ramifications ultimately become purely membranous, and terminate in the air-cells, upon the surface and in the interstices of which the capillary network of the pulmonary arteries and veins ramify. The clusters of air-cells do not communicate with each other, but open into their appropriate bronchial capillaries; and the arterial and venous network on their surface is very close, the diameter of the vesicle exceeding about twenty times that of the capillary artery which is distributed upon it. The object of the above arrangement is, as in many other secreting organs, to obtain a large surface for the circulation of the blood in as compact a form as possible. The other constituents of the lungs, in addition to the bronchi and pulmonary vessels, are the bronchial or nutritious arteries and their corresponding veins; the nerves derived from the pulmonary plexus, consisting of mingled filaments of the sympathetic and paria vaga; and the lymphatics;—all of which are connected and held together by a quantity of cellular tissue. The following points remain for consideration, and constitute the physiological division of this section: 1, the act of respiration; 2, the changes which the air undergoes in the lungs; 3, the changes effected in the blood by its circulation through the lungs.

The act of *inspiration* is essentially muscular, and under usual circumstances performed by the agency of the diaphragm and intercostal muscles; the former elongating, and the latter expanding the thoracic cavity. Ordinary *expiration* is independent of muscular action, resulting from the elasticity of the thoracic parietes during the state of rest which succeeds the inspiratory effort. Many muscles, however, co-operate in producing what is termed forced respiration; thus, the pectoral and serrated muscles act directly upon the ribs in forced inspiration, as the triangular sternal and abdominal muscles do in expiration. Further, the aid of other muscles, whose agency is indirect, is called into operation in fixing the moveable insertions of the inspiratory muscles above enumerated; such are the trapezii, sterno-mastoidei, &c. In the act of inspiration the lungs themselves are perfectly passive; but experiment renders it probable that they have some share in expelling the air with which they are distended, a property which is most likely due to the muscularity of the bronchial ramifications already alluded to. The result of augmenting the capacity of the thorax is to

* Todd and Bowman's *Physiology*, p. 162. J. C. Williams, M.D., *On Diseases of the Chest*. Appendix.

produce a tendency to a vacuum, which the air rushes in to occupy: it is admitted by both nasal and oral apertures; and the reason why it does not find its way into the pharynx is, that there is no such tendency to a vacuum in that direction, but that, on the contrary, the stomach is compressed and the œsophageal opening in the diaphragm contracted during the descent of that muscle. Amongst the forced acts of respiration may be enumerated the following: *coughing*, which is effected by spasmodic contraction of the abdominal muscles supervening on temporary closure of the glottis; the usual cause being irritation in the air passages, which is reflected from the spinal cord to the glottis and abdominal muscles. *Sneezing* is usually preceded by a deep inspiration, but is in itself an act of violent expiration: the cause in this instance is originally propagated from the nares, and the explosive effect is consequent on previous closure of the glottis, and of the posterior nares by approximation of the posterior arches of the palate and retro-pressure of the tongue. *Hiccough*, on the contrary, is a spasmodic inspiratory movement, the contraction of the diaphragm being arrested by the sudden closure of the glottis. *Yawning* is an example of the alternate acts of protracted inspiration and expiration, combined with corresponding affection of the respiratory muscles of the face: it is difficult to assign a proximate cause for this phenomenon. Although an act of volition may arrest, prolong, or otherwise control the respiratory movements, ordinary respiration is essentially an excited act, the nervous centre which receives and propagates the appropriate impression being the medulla oblongata: the excitant is the carbonic acid in the lungs; the centripetal nerve being the par vagum, and the phrenic that which conveys the impression to the diaphragm. The first act of inspiration is attributed by Dr. M. Hall to the impression made on the cutaneous nerves, by the change of temperature to which the fœtus is exposed immediately after birth.*

Changes in the Air.—In relation to respiration, gases may be divided into those which are respirable and support life; those which are positively destructive of life; and those which are only negatively so, by being useless: nitrogen ranks among the last; by it the oxygen is diluted so as to be rendered respirable. The proportions of these two gases in atmospheric air is 79 to 21; the mean quantity of carbonic acid gas in pure air being about four parts in 10,000 volumes. The prominent change which takes place in the respired air is the loss of oxygen and substitution of carbonic acid gas. As regards the nitrogen, experimenters have obtained different results, but most seem to agree in the belief that this gas is both absorbed and exhaled during respiration; and the loss or increase, if any, is but trifling, though varying according to circumstances. The locality and mode of generation of carbonic acid gas has been the subject of repeated experiment and conjecture, for the results alone of which the limits of the present Article will afford space. At each expiration a certain amount of watery vapour is exhaled, which, in round numbers, and taking the mean result of many experiments, may be stated at about sixteen ounces in the twenty-four hours, in an adult: the origin of this vapour was formerly attributed to the combination of the oxygen of the air with the hydrogen of the blood. According to Allen and Pepys, air, once respired, contains about eight per cent. of carbonic acid, which is more than has been obtained by other experimenters: the quantity of pure carbon thus removed from the blood in twenty-four hours would amount to nearly eleven ounces, which Berzelius shows to be improbable from an estimate of the large proportion of solid food that would be requisite to supply anything like this quantity. It has been observed that oxygen disappears, and that carbonic acid is generated in respiration; now, the quantity of the latter which is expired does not account for the amount of oxygen which is consumed, the deficiency varying, according to the results obtained by different experimenters, from one-third to one-tenth, and being much greater in herbivorous than carnivorous animals. All the oxygen respired is not consumed at the first inspiration, but as much as thirteen of the twenty-one parts contained in one hundred cubic inches of atmospheric air are returned. Further, a diminution in the gross bulk of the inspired air is universally admitted, and is doubtless to be accounted for, at least in part, by the condensation consequent on the union of the carbon and oxygen: the mean of the estimates which have been made of this decrease is about $\frac{1}{24}$th of the volume of the air inspired.

Changes in the Blood.—The changes which the blood undergoes by exposure to the air in the lungs may be imitated by admixture with oxygen, as by exposure in a vessel after being withdrawn from the body: the addition of carbonic acid gas blackens it, whilst oxygen renders it a bright scarlet. The specific gravity of purple venous blood rather exceeds that of arterial, being, according to Dr. J. Davy, in the proportion of 1050 to 1047; the latter also differs from the former in being from 1° to $1\frac{1}{2}$° higher in temperature. The further point of contrast noticed by different observers are, that arterial blood coagulates more quickly and contains more fibrin than venous. In addition to the above, the following axioms may be stated as ascertained and determined in connexion with the mutual changes in the air and blood effected by respiration:—1, the arterial blood contains oxygen, and the venous blood carbonic acid; 2, the carbonic acid may be extracted from the blood by the contact of hydrogen or nitrogen; 3, as it is now ascertained that the vapour exhaled from the lungs does not result from a direct combination of the elements in those organs, but is to be regarded in the same light as the cutaneous transpiration, it appears reasonable to conclude that the excess of oxygen is absorbed and unites with the arterial blood, to which it imparts its scarlet colour. The conclusions to be drawn from the above propositions appear to be, that the great object of respiration is to rid the system of carbon; that this is effected by the combination of this element with oxygen; and that nitrogen is the vehicle by which oxygen is diluted and rendered respirable, at the same time that it partially aids in the extraction of the carbonic acid. These facts being admitted, it still remains a question where this chemical union of carbon and oxygen takes place. There appears no reason to doubt that oxygen permeates the air-cells, and is absorbed by the capillary pulmonary arteries at the same time that carbonic acid is given off by the capillary veins: thus a mutual interchange is constantly going on, which is probably referable to the laws by which the varying relation of gases is governed. It therefore seems most probable that

* This subject is treated of more at large in the section on the 'Nervous System,' p. 437.

the carbonic acid is formed in the systemic capillaries; and this hypothesis receives support from the fact that the scarlet and purple colours of the arterial and venous systems is not confined to the blood in the large trunks, but extends to that in their minute ramifications; as well as from the further consideration that, as part at least of the animal heat, which is continually generated throughout the frame, is referable to the disengagement of caloric attending the union of the carbon with the oxygen, it is more probable such evolution would be diffused through the system generally, than that it should be concentrated in the lungs. It is, however, not improbable that this process may take place to a limited extent in the organs of respiration themselves. Dr. Stevens considered that the bright colour of arterial blood was attributable to the agency of the salts which the serum held in solution, rather than to the presence of oxygen.

Physiology of the Larynx as an organ of Respiration and of Voice.—The consideration of the larynx in its relation to the organs of respiration is limited to the mode of protection of the glottis, and the form and extent of the aperture called the rima glottidis. During ordinary inspiration and expiration the glottis remains open, and the larynx is equally passive with the rest of the air-tube; but when the admission of a large body of air rapidly into the lungs is required, the rima is widened by the action of the posterior crico-arytenoid muscles: when it is requisite that it should be closed, as in the acts of vomiting, coughing, or sneezing, this is effected by the contraction of the arytenoid and lateral crico-arytenoid muscles. In the act of deglutition the glottis is closed by the combined depression of the epiglottis and elevation of the larynx. In man and mammalia, the larynx is the primary organ for the production of sound; the further modulation which constitutes articulation is effected by the tongue, lips, teeth, &c. Thus, in the congenitally deaf, articulation is at best but very imperfect: the defect is not in the non-production of sound, but is the consequence of inability to imitate others, except by watching the motions of the lips. Observations and experiments prove that the rima glottidis is the spot where sound is produced, the vibration of the chordæ vocales being the cause. In treating of muscular agency in the production of the voice, it is necessary to bear in mind that the whole body of the larynx may be elevated and depressed; that the vocal chords and the connecting membranes are for the most part elastic; and that the arytenoid cartilages are highly moveable, their development being determined apparently by the extent of surface required for the action of muscles which influence the vocal chords. The muscles by which tension of the chordæ vocales is most directly accomplished are the crico-thyroid and sterno-thyroid; the crico-arytenoidei may also assist by retracting the arytenoid cartilages: on the contrary, the relaxors of the vocal ligaments are the thyro-arytenoid and thyro-hyoid muscles; the arytenoidei may likewise aid as antagonists to the crico-arytenoidei. It is erroneous to suppose that the different laryngeal nerves are distributed relatively and exclusively to antagonist muscles: the lateral and posterior crico-arytenoid, and the thyro-arytenoid muscles receive their supply from the superior laryngeal nerves, whilst the inferior supply the other muscles which move the larynx, in company with branches from the seventh and ninth nerves. Division of the laryngeal nerves is succeeded by loss of voice. The shape of the rima glottidis varies, according to the degree of separation of the vocal chords, from a mere chink to a triangular aperture: between these extremes there are numerous modifications, both in the extent of the opening and the form it assumes. The dimensions of the aperture of the rima does not, however, appear to exercise any important influence over the intonation of the voice, although it has been asserted that it is always narrowed during the emission of sound: this condition has been observed where the larynx has been laid open in attempted suicide. Experiments on the living structures are unsatisfactory and inconclusive: but those on the recent and separate larynx are much better calculated to throw light upon the subject: they are easily performed by fixing the cartilages and imitating the action of the various muscles; and as the vocal chords retain their elasticity for a considerable period, the effect is complete. The result of such experiments clearly proves that the degree of tension of the chordæ vocales is the effective cause of the modulation of that sound which is produced by their vibration; the width of the aperture having apparently no essential influence on the height of the tone, provided the chords are tense: but the notes are, *cæteris paribus*, lower in proportion to the length of the opening of the rima. The chordæ vocales are made tense, in part, by the approximation of the thyroid to the cricoid cartilage; thus, if the finger be placed on the larynx, it will be found that the former is fixed by being drawn up towards the os hyoides, and that the latter then approaches it in ascending the scale. The thyro-arytenoid muscles are important agents in the modulation of tones: they compress the chords, and therefore the rima glottidis, laterally; and must also greatly influence the vibrations of the former, in consequence of the close application of their fibres upon them. The higher tone of voice in females and boys depends upon the relative shortness of the vocal chords, and the obtuseness of the angle of their junction at the thyroid cartilage. The epiglottis has little to do with the voice; but it may, when pressed down, assist in deepening the tones. The whole length of the air-tube appears to be rather shortened than lengthened in producing the higher notes. The arches of the palate and uvula possess no influence; but the oral and nasal cavities and apertures are productive of resonance. According to Müller, the falsetto notes are produced by the vibration of the edges only of the vocal chords. Illustrations of the varied influence which different controlling agents possess in articulation may be readily found in the alphabet: thus, the vowels in the words *ah*, *name*, *theme*, *cold*, *cool*, exemplify, in their pronunciation, the modifying agency of the oral aperture: the explosive consonants, *b* and *p*, illustrate labial articulation: and again *d*, *t*, and *g* exhibit the combined operation of the tongue and palate: *f* and *v* are articulated by the united agency of the upper incisor teeth and lower lip: *s* and *z* are purely dental sounds; but *th* and *sh* require a proper relative adjustment of the tongue, palate, and teeth. Lisping depends on an inability to direct the current of air through the incisor teeth without a disturbing interference on the part of the tongue: the same defect results from the loss of teeth. A consideration of stammering in its varied forms is inconsistent with the limits of the present article.

ANATOMY.

SECTION VIII.

ORGANS OF ABSORPTION.

Anatomy.

The organs concerned in Absorption consist of Glands or Ganglia, and vessels; the latter being further divided into the Lacteals, which convey the chyle from the intestines to the thoracic duct, and the Lymphatics, which hold a similar relation to all parts of the body.

*Lymphatic Ganglia.**—In the extremities these bodies are disposed almost exclusively in the concavity of the joints. In the lower limbs, the *Popliteal* ganglia are three or four in number, and are imbedded in the fat of the ham beneath the fascia. The *Inguinal* ganglia are placed in and near the groin, and consist of a superficial and deep set: the former are more numerous, being usually eight or ten in number, and lying upon and around the saphenic opening of the fascia lata, the deep set are two or three in number, placed beneath the fascia, and close to the femoral artery: one of these occupies the crural ring. The Ganglia of the upper extremity are the *Brachial*, which are scattered along the course of artery from the elbow upwards; and the axillary, which are large and numerous; they are imbedded in cellular tissue around the axillary vessels and nerves, extending upwards to the clavicles, and inwards as far as the costal attachment of the great pectoral muscle. The ganglia met with in the *Head* and *Neck* are (1) two or three small ones upon the parotid gland and beneath the zygoma; (2) upon the buccinator, and around the anterior belly of the digastric muscle; and (3) the superficial and deep cervical ganglia, the former of which lie immediately beneath the Platysma myoides, and the latter (glandulæ concatenatæ) are arranged beneath the fascia in the course of the carotid sheath, from the mastoid process downwards; internally they are in connexion with the pharynx. The *Pelvic* ganglia occupy the iliac, sacral, and hypogastric regions, being situated along the course of the iliac vessels, between the layers of the meso-rectum, and scattered amongst the divisions of the internal iliac artery, where they are related to the different pelvic viscera. The *Lumbar* ganglia are of larger size, and are found principally on either side of the vertebral column, and connected with the sacral ganglia below. The *Abdominal* ganglia are for the most part related to the great vessels in this region, such as the renal and divisions of the cœliac axis: the mesenteric are numerous, and important as associated with the lacteals; they lie between the laminæ of the mesentery, and are not found close to the intestine; but increase in size as they recede from it. Other ganglia are found between the layers of the meso-colon, and along both curvatures of the stomach. The principal *Thoracic* ganglia are found in the anterior mediastinum, and related to the great vessels near the heart; others are met with in the posterior mediastinum and intercostal spaces. The bronchial ganglia vary in number and size, although they are always numerous; they are situated before the bifurcation of the trachea, and surround the bronchi, accompanying them for some distance into the lungs: they are generally soft, and of a blackish colour, yielding a dark pigment, which some have supposed to be carbon separated during the act of respiration.

Lymphatic vessels.—The almost uniform relation of these vessels to the veins renders a minute and particular description of them unnecessary: they are arranged for the most part into superficial and deep sets, and communicate very freely, forming a net-work, particularly in the neighbourhood of large veins. The *superficial* lymphatics of the *leg* accompany the saphena veins, and the *deep* take the course of the tibial and peroneal vessels: some of the former from the back of the leg communicate with the latter in the popliteal ganglia, but the greater portion are collected on the inner and fore part of the thigh, and terminate in the superficial inguinal ganglia: the deep lymphatics continue their course upwards in company with the femoral vessels, and are similarly related to the deep inguinal ganglia. Here also terminate many other lymphatics from the surrounding parts; the superficial inguinal ganglia receiving those of the *hips*, *loins*, anterior walls of the *abdomen*, *perinæum*, *scrotum*, and *penis*. The deep lymphatics of the *penis* and those of the *bladder*, as well as those of the *uterus* and others, accompanying the branches of the *internal iliac* artery, terminate in the hypogastric ganglia. The lumbar ganglia receive the lymphatics of the *testicle* and *kidneys*, and others from the parietes of the pelvic cavity. The *iliac*, *sacral*, and *hypogastric plexus* unite and communicate with the *lumbar plexus* of lymphatics, which, becoming fewer and larger, ultimately empty themselves into the receptaculum chyli. The lymphatics of the *arm* are also *superficial* and *deep*: the former accompany the cutaneous veins, the latter the deep vessels, to the bend of the elbow, whence they ascend together to the axilla, where they terminate in the axillary ganglia; and subsequently, after communicating with the lymphatics of the head and neck, they terminate on the left side in the thoracic duct, and on the right they empty themselves by a short canal (small thoracic duct) close to the union of the right jugular and subclavian veins.

The axillary ganglia also receive the lymphatics from the walls of the *thorax*, the posterior part of the *neck*, and the *dorsal* region: the superficial lymphatics of the *head* join those of the *face*, which, together with those of the *orbits* and *nose*, and of the *tongue*, *palate*, and *pharynx*, ultimately terminate in the thoracic duct of their relative sides: some of these first pass through the parotid and submaxillary ganglia. The

* The title of 'Ganglia' is preferred to that of 'Gland,' as the bodies to which it is applied do not possess the ordinary properties or characters of secreting organs: indeed their function is very obscure.

lymphatics of the *chest* consist of those which are met with in the interior of the walls, on the diaphragm, pericardium, and in the posterior mediastinum: those of the *heart* accompany the arteries of that organ. The *pulmonary* lymphatics are superficial and deep: the former form a net-work beneath the pleura, and the latter are distributed through the interior of the lungs: they terminate in the bronchial ganglia. All the above lymphatics ultimately empty themselves into the left or small right thoracic duct; occasionally some of them may be traced separately into the jugular or subclavian vein. In the *abdomen* the lymphatics of the *spleen* and *liver* are disposed in two planes, and are numerous and large in the latter organ, which they quit at different points, and ultimately pass by the anterior or posterior mediastinum to the thoracic duct, into which they empty themselves near to its termination. The lymphatics of the *stomach* are found on either surface of its muscular tunic, and accompany the arteries to the spine, where they join the thoracic duct. The *pancreatic* lymphatics have a similar termination. Lastly, the *lacteal* vessels (accompanied by other lymphatics) lie between the layers of the mesentery; and, after passing through the ganglia in this position, they become fewer in number and larger in size, and terminate in the thoracic duct. The *Thoracic duct* is the canal through which the chyle and greater part of the lymph is conducted to the venous system. It commences by the union of the large lymphatics from the lower part of the body, and the lacteals, upon the body of the second lumbar vertebra, at which point there exists a pouch-like dilatation, named *Receptaculum chyli*. It then ascends between the crura of the diaphragm, and through the posterior mediastinum, having the aorta on the right, and the vena azygos on the left, and being posterior to the œsophagus. Opposite the fifth or sixth dorsal vertebra, it crosses the spine obliquely to the left, and subsequently ascends behind the arch of the aorta to the interval between the parallel carotid and subclavian arteries of the left side, lying upon the longus colli muscle, and rising to a level with the seventh cervical vertebra. It then bends rather abruptly downwards and inwards, behind the inferior thyroid artery and left internal jugular vein, and terminates in the junction of the latter with the subclavian of the same side, the orifice being guarded by a pair of valves. In this course the Thoracic duct not infrequently divides several times, and again unites. It receives, at various points, the different lymphatics of the abdominal and thoracic parietes and viscera, as well as those from the left side of the upper half of the body. The corresponding branches from the right side empty themselves (as already described) by the *small Thoracic duct*, into the junction of the right subclavian and jugular veins.

Structure and Functions of the Lymphatics.—These minute vessels are most readily demonstrated in the mesentery of an animal shortly after being fed. In structure and distribution they are closely allied to the veins, but are more delicate in texture, and are less easily divisible into layers or coats. They are elastic, and capable of considerable distension; presenting also a most elaborate interlacement, from the infinity of anastomoses which exist between their branches, and possessing valves which occur in pairs at short intervals. Their inner or lining membrane is, like that in blood-vessels, smooth and polished, the outer being cellular and elastic. Lymphatic vessels are most numerous, as might be anticipated, in the most highly organized structures, with the apparent exception of the brain and nervous system, where they have not yet been traced, although they doubtless exist. The chief peculiarity of the absorbents is their association with the ganglia which have been described. These bodies are very vascular, but the nature of the influence they exercise over the lymphatics and their contents is not clearly ascertained.* The structure of the Lacteal vessels is identical with that of the lymphatics generally, their peculiar office being to convey the chyle from the intestines to the thoracic duct.† The exact relation of the ultimate branches of the lymphatic system to the textures in which they commence is not understood; and a careful examination of their exact relation to the ganglia through which they pass merely exhibits them subdividing minutely in these bodies, and again emerging as single trunks from them. It is probable that their absorbent power is principally referable to capillary attraction. However this may be, the "vis a tergo" has been known to be sufficient to burst the thoracic duct when compressed by a ligature; a fact which further illustrates the perfection and importance of the valvular arrangement. That the absorbents may be rendered more active under certain circumstances, appears to be proved by the judicious employment of mechanical or appropriate medicinal stimulus: it may, however, be questioned how far the phenomena alluded to may not be referred to a controlling influence exercised over the depositing vessels. Lymph nearly resembles the serum of the blood, but possesses corpuscles and a small quantity (about $\frac{1}{2}$ per cent.) of fibrin, whence it derives its property of coagulating. The different periods of life present remarkable variations in the relative activity of the absorbing and depositing vessels, as illustrated by the frame during childhood, at the adult period, and in old age: both processes are continually at work, by which a certain balance is maintained, and the interruption of which, to any extent, is either the result of unhealthy action, or itself constitutes disease.

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* See 'Glandular Tissue,' p. 447.

† See 'Organs of Digestion,' p. 449.

SECTION IX.

URINARY SYSTEM.

The organs by which the urine is secreted and conveyed to the bladder are contained in the abdomen: the last-mentioned membranous viscus occupies a part of the pelvic cavity. The *Pelvis* consists of three large bones, bound strongly together, and immoveable on each other; hence it forms a remarkable contrast to the distensible parietes of the thorax. It is divided into true and false pelvis: the former contains the organs of generation in the female, the rectum, and bladder; whilst the abdominal viscera rest on the iliac bones, above the ilio-pectineal lines. Of the upper strait of the pelvis the sacro-pubic diameter is the smallest, and the iliac or transverse the largest: on the contrary, the antero-posterior diameter of the inferior outlet exceeds that of the transverse, and is variable on account of the mobility of the coccyx. A line passing from the centre of the upper strait backwards, indicating its axis, would strike the lower third of the sacrum; that of the inferior, passing upwards, would strike the sacro-vertebral prominence, forming an obtuse angle where it meets the other line in the middle of the pelvic excavation. The female pelvis differs from the male in presenting a greater general capacity, its surfaces and prominences being smoother and less abrupt: the ilia are also more expanded or unfolded, and hence the hips are more prominent; the sacro-vertebral angle is not so marked, the sacrum is wider, and the angle of the pubic arch less acute; the sciatic tuberosities are set more outwards, and the acetabula are further apart. Lastly, as a consequence of the preceding peculiarities, the outlets of the female pelvis are larger than in the male.

The *Kidneys* occupy each lumbar region, lying on the quadratus lumborum and part of the diaphragm and psoas muscle, opposite to the last two dorsal and upper two lumbar vertebræ. Each is covered anteriorly by peritoneum; and the right has in front of it the duodenum and ascending colon, and the left is covered by the descending colon. Of the two kidneys the right is usually lower than the left, a peculiarity dependent on the position of the liver, with which it is in contact above. The upper extremity of the left kidney touches the spleen: the inferior margin of each touches severally the head and sigmoid flexure of the colon. The position of the kidneys is not exactly vertical, the superior or larger extremity approaching nearer to the spine. The external border of each is convex, and faces outwards and backwards; the internal edge is deeply notched where the vessels enter and the ureter makes its exit. The relative position of the arteries and veins here is not constant, but the former are usually behind the latter: the ureter is always posterior and inferior to both. Each kidney is invested by a dense fibrous capsule, which accompanies the vessels into its interior. A section of the kidney shows its interior to consist of a dark substance of a reddish brown colour, composed almost exclusively of the ramifications of the vessels. Internal to this, a paler structure (the tubular) is arranged in conical prominences (papillæ), the apices of which converge towards the centre of the organ, and are surrounded by membranous sacs called calyces. The papillæ present, on section, a linear arrangement of vessels (tubuli uriniferi), which open upon the surface of these cones. The membranous sacs are five or six in number, each containing one of two papillæ. The former unite into three tubes, named infundibula, which again join to form one large membranous bag, the pelvis. This contracts to form the ureter. The renal duct, or *Ureter*, extends from the pelvis of the kidney to the bladder, its ordinary length being about eighteen inches, and its diameter that of a common writing quill. The course of these ducts is obliquely downwards and inwards, crossing the psoæ muscles and the bifurcation of the common iliac artery: they adhere to the peritoneum which covers them, and are crossed by the spermatic vessels; also in the pelvis by the vas deferens in the male, and by the Fallopian tube in the female. The ureters contract in size as they approach their destination; and, behind the vesicula seminalis, each perforates the coats of the bladder very obliquely, to terminate about an inch and a half from its fellow, and the same distance from the orifice of the urethra. In the female the latter interval is somewhat less. The constituents of the ureter are, an external fibrous tunic, and one of mucous membrane within.

The *Supra-renal bodies* may here be noticed. They are attached to the upper extremity of each kidney, narrow above and broad below: their interior is excavated, and contains a brown fluid. Their use is unknown, though their large development in the fœtus would seem to indicate that their function is principally, probably exclusively, confined to uterine life.

The *Urinary Bladder* occupies the pelvis, but, when distended, ascends into the hypogastric region of the abdomen. It is of an oval form, its long axis being represented by a line passing from midway between the umbilicus and pubes to the extremity of the coccyx. Before the pelvis is fully developed, as in children, the bladder is more excluded from this cavity, and is pyriform in shape. Superiorly, the small intestines rest upon the bladder, and the urachus and hypogastric arteries are attached to it; inferiorly, it rests on the ureters, and in the male on the vesiculæ and prostate gland, but in the female on the vagina. Anteriorly, it is in contact with the recti muscles and posterior aspect of the pubes; posteriorly, the rectum is in contact with it in the male, but in the female the uterus intervenes. Lastly, the lateral regions are separated from the walls of the pelvis by the levatores ani

and pelvic fascia. The bladder is partially covered by peritoneum, and this investment varies in extent according to the degree of distension of the bladder. When collapsed, a cul-de-sac is formed between the pubes and bladder, as well as between the bladder and rectum. The folds into which the peritoneum is thrown around the bladder are called its false ligaments. These are the posterior, which connect it to the rectum, and contain the ureter and obliterated hypogastric artery on either side; the lateral, which extend to the iliac fossæ, and contain the vasa deferentia in the male, and round ligaments in the female; and the superior fold, which connects the summit of the bladder to the recti muscles, and contains the urachus and hypogastric vessels. The true ligaments of the bladder are formed by the pelvic fascia, which is continuous with the iliac fascia of either side. In tracing this fascia, it is found to be separated into two laminæ by the interposition of the levator ani muscle; the external or obturator layer adhering to the obturator internus muscle, and closing the inferior outlet of the pelvis by its attachment to the tuberosities and rami of the ischium, the rami of the pubes, the triangular ligament of the urethra, and the great sciatic ligament. The vesical layer of the fascia is extended between the levator ani and peritoneum, and forms the true ligaments of the bladder: it is reflected from the walls of the pelvis laterally, upon the sides of this organ and the prostate gland; forming the lateral supports of the bladder, and extending forwards to the lower border of the symphysis pubis, whence it is reflected upon the upper surface of the prostate gland and neck of the bladder, where two folds are formed, named the anterior ligaments of the bladder. Posteriorly, this fascia becomes cellular in character, and is connected to the sides of the rectum, and surrounds the vessels and nerves. The bladder consists of an external serous coat, which has been already described as partial; and of an internal or mucous lining, which is continuous with that of the ureters and urethra. Between these is the muscular coat, which consists of strong red fibres, or rather bundles of fibres, which are spread in different directions over this hollow viscus, the superficial being principally longitudinal, and more distinct on the anterior and posterior aspects of the bladder than they are on its sides. The deeper fibres have an annular arrangement, and are most developed near the neck of the bladder. A layer of condensed cellular membrane connects the muscular to the mucous coat. The oblique perforation of the different tunics of the bladder by the ureters prevents the retrograde course of the urine when this viscus is distended; and it is expelled by the action of the detrusor muscle through the urethra.

Structure of the Kidney.—The most recent investigations into the minute anatomy and physiology of the kidney are those of Mr. Bowman.* The representations of the renal circulation in mammalia, which accompany the paper here alluded to, exhibit the extreme branches of the artery giving a terminal twig to each Malpighian tuft, from which emerges the efferent vessel: this enters the plexus of capillaries surrounding the uriniferous tube; and from this plexus the emulgent vein springs. The Malpighian bodies comprise but a small part of the inner surface of the kidney, there being but one to each tortuous tube. Mr. Bowman considers the peculiar arrangement of the vessels in the Malpighian tufts to be clearly designed to produce a retardation in the flow of the blood through them; and, he adds, " the insertion of the tuft into the extremity of the tube is a plain indication that this delay is subservient in a direct manner to some part of the secretive process." The peculiar arrangement alluded to, the same author thinks to be connected with the large proportion of aqueous particles contained in the urine. Mr. Bowman concludes by remarking the striking fact, " that the proximate principles of the urine, like those of the bile, are secreted *in all animals* from blood which has already passed through one system of capillaries—in a word, from portal blood; although it does not appear to what extent its qualities are changed by traversing the Malpighian system."† The secreted urine is ultimately poured out on the surface of the papillæ, where it is received by the calyces, and transmitted from them, through the infundibula, to the pelvis and ureter, and thence to the bladder. Recent urine, in the human subject, is of an amber or straw colour, varying in intensity according to its degree of dilution, or the presence of some of its constituents in excess: its reaction is decidedly acid, in health; but it becomes alkaline in some diseases, and by decomposition. The most essential constituent of the urine is urea, of which it contains about three per cent.; ninety-three parts being water, and the rest consisting of lactic and uric acids, and the salts of ammonia, soda, potash, lime and magnesia, with osmazome, extractive matter, and a trace of silica.‡

* The reader is referred to the original paper for particulars: it is in the *Philosophical Transactions*, part i., for 1842, p. 57.
† *Loc. cit.* p. 77.
‡ Berzelius, *Chimie Animale*, p. 342.

A N A T O M Y.

SECTION X.

OF THE ORGANS OF REPRODUCTION.

The *Male Organs* of Generation include the glands for the secretion of the fœcundating and other fluids, and the apparatus for conducting such secretion to its destination: the course of the semen will be followed in the ensuing description. The Testicles, which are two in number, are suspended in a bag called the *Scrotum.* This sac consists of skin which is continuous with that of the abdomen and thighs, but modified in texture, being very thin and lax, and presenting many sebaceous follicles and hairs scattered at intervals over its surface: it also presents a central ridge which is continuous with the raphé of the perinæum: the subcutaneous cellular tissue is devoid of fat. Beneath the skin is a texture peculiar to this part named the *dartos;* it is vascular and reddish in appearance, and is possessed of a contractile property: its connexions are to the rami of ischium and pubes laterally, and to the under part of the urethra in the mesial line, thus assisting in forming the partition between the testicles. The superficial fascia of the abdomen descends around each spermatic cord, and forms a distinct investment to either testicle. Beneath this are seen the expanded fibres of the cremaster muscle, which are spread over the fore part and sides of the testicle. The *tunica vaginalis* and *albuginea* are the more direct coverings of this gland: the former of these is a serous membrane, and originally a production from the peritoneum: it is loosely connected to the scrotum, but adheres firmly to the fibrous tunic of the testicle; the epididymis is the line of reflection, and its posterior margin is consequently left uncovered: it invests the cord to a limited extent. The dense fibrous coat of the testicle is named, from its appearance, *tunica albuginea;* and to it the peculiar form of this pulpy gland is due. Productions of this membrane extend into the interior of the testicle in the form of septa, to be presently noticed. In shape the *Testicle* is oval and somewhat flattened; its position in the scrotum is oblique, and the left usually hangs rather lower than the right. A section of the testicle exhibits its structure to be of a grey colour and pulpy consistence; it is made up of minute tortuous vessels, disposed in bundles, which are separated from each by the fibrous septa which project inwards from the tunica albuginea: these bands are continuous with the mediastinum testis, a broad process of the fibrous tunic which projects into the back of the gland, and consists of two laminæ enclosing the spermatic vessels and nerves: this process is broadest above where it is perforated by the excretory ducts. The tubuli seminiferi (as the minute spermatic ducts are called) unite to form larger vessels (tubuli recti), which vary in number from fifteen to twenty, or upwards: these take a parallel direction to the back part of the gland, where they are found between the layers of the mediastinum intermingled with the other vessels and nerves; they again unite into fewer and larger tubuli (vasa efferentia) which pierce the tunica albuginea, and ultimately form one single duct, the vas deferens. The *Epididymis* is an oblong body, narrow in the centre and bulbous at either extremity: its position is along the back part of the testicle, to which it is connected by the vasa efferentia above, and by the reflection of the tunica vaginalis through the rest of its course. Its upper extremity is named its head, and consists of the convoluted vasa efferentia; the globus minor, or tail, and intervening body are constituted of the coiled vas deferens, which at length becomes isolated, and assuming a denser character and larger size, it takes a serpentine course along the inner border of the epididymis, at the upper extremity of which it becomes connected with the other constituents of the chord, posterior to which it lies; and with them traverses the inguinal canal to enter the abdomen. At the internal ring the vas deferens leaves the other vessels, and, after hooking round the epigastric artery, descends backwards and inwards along the side of the bladder, crossing in its progress the psoas and iliacus muscles, the external iliac vessels, and obliterated hypogastric artery; it now approaches its fellow, at first lying anterior and then internal to the ureter, and next between the bladder and rectum; lastly, it passes to the inner side of the corresponding vesicula seminalis, the duct of which it joins as they together penetrate the prostate gland to enter the urethra.

The *Vesiculæ Seminales* are a pair of membranous canals with lateral appendages, convoluted in such a way as to assume an oval form: their position is between the inferior part of the bladder and the rectum, and above and behind the prostate gland, to which their anterior extremities are attached: the ureters are behind them, and the vasa deferentia are attached to their inner margins. The coils of the vesiculæ are so arranged as to present the appearance of an aggregation of cells: the duct of each joins that of the vas deferens. The *Prostate* is a conglobate gland, of firm and dense structure and grey colour, which surrounds the commencement of the urethra in the form of a truncated cone. It is covered superiorly by the posterior reflection of the triangular ligament, and inferiorly it rests upon the rectum; its sides are covered by the levator ani, and its base surrounds the neck of the bladder; whilst its apex extends to the membranous part of the urethra. The great bulk of the prostate is behind and on the sides of the urethra, and a superficial groove on either surface marks the junction of the lateral lobes, the central connexion between which

has been named the middle lobe: the base of the gland is notched at the entrance of the common ejaculatory ducts. A dense capsule (the posterior layer of the deep perinæal fascia) envelopes the prostate, and is continued into that part of the vesical fascia which forms the anterior ligaments of the bladder and covers the upper surface of the gland. The prostatic ducts, to the number of ten or fifteen, open principally on the lower surface of the urethra, on the sides and surface of the Verumontanum. Anterior to the prostate, and lying between the layers of the deep perinæal fascia on either side of the membranous portion of the urethra, are two small *accessory glands*, first described by Cowper, and named after him: they are granular, and each about the size of a pea, possessing a small duct, about half an inch in length, which runs forward and opens into the spongy part of the urethra, immediately in front of the bulb.

The *Penis* is a cylindrical erectile organ which, in its relaxed condition, is pendent from the pubes, and rests upon the scrotum between the testicles. It is covered by the common integument, which is thin and connected to the body of the organ by lax cellular tissue wholly devoid of adipose matter: this skin extends beyond the extremity of the penis, forming the prepuce, and is then reflected on to the glans, where it becomes extremely delicate, and is ultimately continuous with the mucous membrane at the orifice of the urethra. A fold of the prepuce attached to the notch on the under part of the glans is named the frænum; it limits the uncovering of the penis, and probably may render the emission of the semen more forcible by acting on the urethral orifice during erection. At the junction of the prepuce and glans, and especially in the neighbourhood of the frænum, are a number of sebaceous follicles, named glandulæ Tysoni. A production of superficial fascia from the abdomen is continued around the penis, becoming more delicate as it advances, and terminating at the corona glandis. The body of the penis consists of the two corpora cavernosa, beneath which, and in the angular interval between them, the urethra is lodged: their extremities are surmounted by the glans penis, which is an expansion of the corpus spongiosum urethræ. The Corpora Cavernosa spring from two roots or crura, each of which is attached to the inner border of the corresponding ramus of the ischium, immediately in front of the tuba ischii, and adhering also to the ramus of the pubes: they are covered internally by the erectores penis muscles, and unite in front of the pubic arch. The anterior extremity of the conjoined cavernous bodies is conical and truncated: their junction above is marked by a groove, in which are lodged the two dorsal arteries and vein of the penis, whilst a deeper furrow beneath lodges the urethra. A flattened band of white fibres extends from the under and fore part of the symphysis pubis to the dorsal surface and posterior extremity of the cavernous bodies, under the name of suspensory ligament of the penis. The structure of the corpora cavernosa is essentially fibrous externally, and spongy or cellular within: a partition, consisting of flattened fibres, separates the two, and from its comb-like arrangement is named septum pectiniforme: this permits of a free interchange of vessels between the two sides of the organ. Their spongy texture consists of an intricate arrangement of fibrous and cellular bands, and the result is the production of a number of small cells, around and in which the vessels ramify.

The *Urethra* is the excretory duct common to the urinary and genital organs: it is from nine to twelve inches in length, extending from the bladder to the extremity of the glans penis, and lined throughout by mucous membrane, which is continuous with that of other parts of the genito-urinary system. The urethra is divided into different compartments, which vary slightly in calibre, and more importantly in other points, according to the structures by which it is surrounded: these divisions are severally named prostatic, membranous, bulbous, spongy, and glandular: its course is serpentine, and its interior presents the openings of the common ejaculatory, prostatic, and Cowper's ducts, in addition to those of many submucous follicles. The prostatic portion of the urethra somewhat exceeds an inch in extent: its direction is obliquely downwards and forwards, and it is nearer to the upper than the lower surface of the gland, the thick posterior wall of which alone separates it from the rectum: the interior of this division presents a central dilatation on either side of the median line, named the prostatic sinuses, between which and inferiorly is a prominent fold of the mucous membrane, named Verumontanum or caput Gallinaginis: in the middle of this fold a large lacuna opens, and on either side of it is the orifice of the common ejaculatory duct; the apertures of the prostatic ducts themselves form a cresentic range in either sinus. The membranous division is little more than half an inch long, and lies beneath the pubic arch, where it is supported by the deep perinæal fascia, which is reflected before and behind it, and by the conjoined anterior fibres of the levatores ani: its calibre is a little contracted, and its walls are thin: a plexus of veins from the dorsum of the penis is interposed between it and the pubes. The spongy portion of the urethra extends forwards from the last division to the extremity of the glans: it is so named from the texture which surrounds it, and constitutes about three-fourths of its whole length: the fibrous membrane which envelopes it is thinner than that of the corpora cavernosa, but its structure is essentially cellular and erectile, and similar in nature to that of the crura. The commencement of the corpus spongiosum is named the bulb, which is an expansion of this erectile tissue, occupying the angular interval between the crura penis near their junction: it projects backwards, and is invested by the anterior reflection of the deep perinæal fascia. The calibre of the urethra is here augmented in a marked manner, though not nearly in proportion to the circumference of the bulb itself. In front of the bulb the spongy portion of the urethra again contracts, and continues of uniform dimensions through the rest of its course until it approaches the glans: immediately in front of the sinus of the bulb are the openings of Cowper's ducts. The *glans penis* is a further expansion of the spongy texture above described, on the anterior and lateral parts of the urethra: it is invested by a delicate cuticle, and has a pink appearance: its size varies according to its degree of distension, and its form is that of a cone surmounting the corpora cavernosa, with its under part sliced obliquely: the apex of this cone presents the extremity of the urethra, which is an elongated aperture closed by lateral lips: the base of the cone is bounded by a prominent ridge which encircles the glans obliquely, and is named the corona glandis. The

interior of the spongy division of the urethra exhibits the orifices of several lacunæ, the largest of which are on its upper surface, and all are directed forwards: these become more numerous towards the glans, near which one larger than the rest is named the lacuna magna. In the glans itself a remarkable transverse dilatation of the canal exists, which is called the fossa navicularis; whereas the orifice of the urethra is contracted so as to present the appearance of a vertical slit.

Structure and functions of certain parts of the Male Organs of Generation.—The texture of the *Dartos* has been a frequent subject of dispute amongst anatomists: that it possesses contractile properties there appears to be no question; and its action seems more allied to the vermicular or peristaltic motion of the involuntary muscles than any other. A recent author remarks that muscular fibres of the unstriped variety have been detected in its structure, to which the contractility of the dartos is due; and adds that the reason of their having been previously overlooked depends on their admixture with a great abundance of areolar tissue, which is nothing more than a modification of the same texture common to that region. The minute structure of the *Testis* presents several points for consideration. The convolutions of the tubuli seminiferi are so arranged that each lobule is a cone with its apex towards the rete testis: the last-named body consists of from six to twelve serpentine vessels, which receive the tubuli recti and anastomose with each other, being contained between the laminæ of the mediastinum or corpus Highmori. The vasa efferentia leave the rete, being at first straight and afterwards convoluted: they are (according to Louth) from ten to thirty in number, about eight inches long, and diminish in size as they approach the epididymis. The average length of the canal which forms the epididymis is about twenty feet. The diameter of all the tubuli is the same, being, according to Louth, $\frac{1}{170}$ of an English inch; and that of the vasa recta is $\frac{1}{99}$. The same author states that each lobule contains one, two, or (sometimes) several tubuli. He reckons the number of tubuli at 840, the length of one being about two feet: they anastomose freely only towards their extremities, nevertheless they rarely present free ends. From the above description it is apparent that the whole internal surface performs the office of secretion. A cœcal appendage of variable length, which probably secretes a peculiar fluid, usually joins the vas deferens where it leaves the epididymis; this is called 'vasculum aberrans.' The calibre of the *Vas deferens* is by no means proportioned to its diameter: its coats are thick and wiry to the feel, —a peculiarity affording the necessary resistance to pressure, which would interfere with the flow of the secretion. It has been thought by some that the *Vesiculæ seminales* were receptacles of the semen: their character and organization render it more probable that they furnish an additional secretion to lubricate the passages or dilute the fœcundating fluid. The *Prostate gland* is an example of the aggregation of several compound follicles into a single mass, or, in other words, a collection of smaller glands, each constituting a ramified tube with cellular extremities: its secretion is viscid and transparent. Professor Müller has given a particular account of the vascular arrangement in the *Corpora Cavernosa* penis: he describes the arteries as having two terminations, one of which is similar to that of other arteries, viz. for nutrition, and communicating with the minute radicles of the veins. The other set are derived from the sides of the arteries, and consist of short curled branches which are sometimes single, at others form tufts, and terminate abruptly, by apparently closed extremities. These, which he names *arteriæ helicinæ*, project into the venous cells, and are chiefly detected in the posterior part of the corpora cavernosa, and corpus spongiosum urethræ. The Professor conjectures that, though these helicine arteries present no openings, the blood is poured, during erection, from them into the venous cells, whence it would be subsequently and gradually absorbed by the veins. The proximate cause of this increased local action is an unexplained phenomenon, though probably referable to the same agency as that which accomplishes partial and temporary vascular activity in other parts and under other circumstances.* The opinions of Professor Müller have not received universal sanction; and others have failed to observe all that he describes. Whatever may be the correctness of the anatomical description just alluded to, the following facts seem to be apparent: that, for the production of *erection*, the blood must be retarded in the cells and veins of the penis, whilst it is still transmitted by the arteries. This may be effected in the following way by muscular action: the erectores penis command the corpora cavernosa, and by their action may therefore prevent the return of venous blood from them; at the same time that the acceleratores urinæ compress in like manner the spongy body of the urethra: this latter operation is further accelerated by the distension of the corpora cavernosa compressing the dorsal vein of the penis against the pubic arch. This explanation will transfer the seat of nervous operation from the vessels to the muscles; and it seems reasonable to suppose that, whatever may be the *primum mobile*, the phenomenon is mainly accomplished by that reflected nervous energy to which the remaining steps of the process, even to the consummation of the act of coitus by emission, are attributable. The persistent action of the erector muscles, and the spasmodic compression of the distended bulb by the ejaculators are acts wholly independent of volition.†

During the early part of fœtal life the Testicles lie within the abdomen, resting on the psoæ muscles, beneath the kidneys, and receiving, like these organs, a partial covering from the peritoneum. Each testicle is, at this period, attached to the pubic symphysis by a fibrous cord, named *Gubernaculum testis*, which extends through the inguinal canal and rings. This cord is broadest above, and presents a very small canal. By the gradual contraction of the gubernaculum the testicle is approximated to the internal ring, and about the beginning of the eighth month it commences its descent through the inguinal canal to the scrotum, carrying with it a reflection of the peritoneum, which is folded around it so as to form a partial, but double, investment to the organ. The communication between this production of the serous membrane and the general cavity of the peritoneum is subsequently cut off, and that portion which covers the greater part of the cord also degenerates into cellular tissue; so that the tunica vaginalis thus becomes a distinct and independent

* This subject has already been discussed under the head of the 'Vascular System.'

† For further particulars on this head, reference may be made to the 'Sense of Touch,' p. 431.

Anatomy. serous sac, closely embracing the testicle and reflected along the line of the epididymis, as already described.

Female Organs.—The external organs of Generation in the female consist of the following parts. The *mons Veneris*, an adipose cushion in front of the pubes: this, in the adult, is covered with hair. The term "*vulva*" is applied to the external opening of the vagina. It is a fissure which extends backwards to within an inch of the anus, and which presents a superior commissure where the external labia are united above, and an inferior commissure, behind which and between it and the anus is the short perinæum. The external or proper *labia* are thick folds of integument which bound the vulva on either side; and within these are the *nymphæ* or smaller labia, which diverge as they descend from either side of the clitoris, and are gradually blended below with the common integuments of the vulva: they contain erectile tissue. The *clitoris* is within the vulva, and a little below its superior commissure: it is composed of elements analogous to those of the penis, possessing crura, which are attached to the rami of the pubes. These unite and are surmounted by a glans, around which a prepuce is folded: the structure of this body is cellular, like that of the spongy portion of the male urethra, and is capable of similar erection. The orifice of the *urethra* is situated about half an inch below the clitoris: this passage is very short in the female, being barely two inches in length. Its position is above the vagina, and it takes a curved course upwards and backwards beneath the symphysis pubis, to which it is connected by a production analogous to the triangular ligament in the male perinæum. The circular orifice of the external meatus is studded with mucous glands. The *Vagina* leads upwards from the vulva, and is attached internally around the neck of the uterus: it is surrounded externally by an annular muscle (analogous to the accelerator urinæ in the male), which extends from the clitoris around the vagina, and acts as a sphincter muscle. The clitoris possesses erector muscles similar to those of the male penis; and the other muscles of the perinæum and anus are alike in both sexes. The entrance to the vagina is originally partially closed by a reduplication of the mucous membrane (*hymen*), which leaves a circular aperture. After coition it ceases to exist, and in its place small red prominences are seen, named the myrtiform caruncles. In examining the form and course of the vagina, it is found to be about six or eight inches in length, and slightly curved, its concavity looking towards the bladder. Its lateral diameter exceeds its antero-posterior, and it is most capacious in the centre: its posterior wall is also much longer than its anterior, and is partially covered by the peritoneum, which descends to form a cul-de-sac between it and the rectum. The constituents of the vagina are an external fibrous tissue, which presents a plexiform arrangement of vessels, giving the part an erectile character, especially near the vulva; and a lining of mucous membrane, which is thick and dense, studded with mucous follicles, and presenting transverse folds or rugæ. The *Uterus* and its appendages constitute the internal organs of generation in the female. The position of the uterus is between the rectum and bladder: it is about two inches in length, and its breadth is rather less. Its superior extremity is expanded, and named its fundus, to which its narrow neck inferiorly is connected by the intervening body. The cervix uteri is embraced by the vagina, which extends higher on its posterior than on its anterior aspect. The body of the uterus is flattened, its antero-posterior diameter being little more than the thickness of its walls. That portion of the organ which projects into the vagina, presents the mouth of the womb (os tincæ), which is a transverse fissure bounded by smooth lips, of which the anterior is the thicker. The cavity of the uterus is very small: superiorly and laterally are the small orifices of the Fallopian tubes: it is lined by a layer of delicate mucous membrane which is continuous with that of the vagina, and sends a prolongation into either Fallopian tube. The serous investment of the uterus is derived from the peritoneum, in its progress from the back of the bladder to the rectum. On either side of the womb this reflection is intercepted by the Fallopian tubes, and thus forms a broad fold, expanding laterally, and dividing the cavity of the pelvis into two compartments. The ovaries and round ligaments are also contained between the layers of this reduplication, which is named the broad or suspensory ligament of the uterus. The round ligaments are attached to the upper or fore part of the uterus laterally, in front of and below the connexion of the tubes. They pass upwards, outwards and forwards to the internal rings; and after traversing the inguinal canals, terminate by expanding on the mons Veneris: they consist of condensed cellular tissue and several vessels. The *Fallopian tubes* are two canals, which lie in the superior folded border of the broad ligaments: they are four or five inches in length, and extend from the angles of the fundus outwards, expanding towards their extremities, and terminating by open fringed mouths, called their fimbriated extremities. The *Ovaries* are enclosed in the folds of the broad ligaments, occupying the interval between the round ligaments and Fallopian tubes, and placed very near to the open extremities of the latter, being, in fact, usually partially attached to one or more of the fimbriæ. The inner margin of each ovary is connected to the uterus by a ligament about an inch and a half long: the appearance of these organs is not unlike that of a small compressed testicle, and they are surrounded by a fibrous capsule similar to the tunica albuginea of that organ.

Structure of the Uterus and Ovaries.—The walls of the uterus are about half an inch thick, and its proper texture is close and resisting; its colour is grey; it is very vascular, and the arrangement of its fibres very complex. Although its properties, at the period of parturition, essentially identify it with muscular fibre, its actual muscularity has been always questioned from the absence of the usual characteristics of this tissue. Recent investigations, however, seem to leave no doubt of its belonging to the unstriped variety of muscular fibre—a peculiarity which has led to its being overlooked by earlier investigators. A section of the ovary exhibits several small vesicles, containing a viscid fluid. Some are delicate and pellucid; others are evidently more vascular, and contain a yellowish or brownish fluid. Some of these vessels encroach upon the surface, and others, having actually burst, leave a cicatrised spot behind.* Dr. Barry has recently com-

* For the physiological division of this section, the reader is referred to p. 126, of Vol. 8; and for a description of the Female Mamma, to p. 139 of the same Volume.

municated the interesting fact of his having observed the spermatic animalcules on the ovary.

A close analogy may be traced between the apparently dissimilar external organs of generation in the male and female. The clitoris overhangs the orifice of the urethra, and has attached to either side of it the superior extremities of the nymphæ. If these last bodies were connected throughout their whole extent they would represent a continuation of the urethra, which would then terminate, as in the male, at the glans clitoridis. The most common forms of spurious hermaphroditism are associated with these analogies; viz., excessive development of the clitoris in the female, and hypospadic fissure of the urethra in the male.

True *Hermaphroditism*, which is the most frequent sexual arrangement in plants, is rare in the Animal Kingdom. Where it is found it exists in one or two forms, impregnation resulting from the concurrence of two or more individuals in which both sexes are developed, or in one individual independently. Many Mollusca and Radiata present illustrations of those forms of hermaphroditism which only exist as an abnormal development in the Articulate and Vertebrate classes. The different forms of spurious hermaphroditism, such as are met with occasionally in the human subject, are usually the result of arrested development. The distinction of sex does not take place in the human embryo until after the completion of the third month, when the margins of those small folds of integument which become the *nymphæ* in the female, are approximated to form the closed *urethra* of the male; the *labia majora* further corresponding to the folds which constitute the *scrotum* for the reception of the testicles. The concurrent existence of fissured urethra, with retention of the last-mentioned glands within the abdomen, and imperfect general development of the body, constitute the most common form of spurious hermaphroditism in the human subject, the true sex being, however, masculine. Abnormal development of the clitoris, and prolapse of the uterus in the female, have also given rise to doubts respecting the true sex. But the rarer instances, which present the nearest approximation to that perfect condition of double sexual development which is met with in the lower classes of animals alluded to, are those in which there exists an actual admixture of the genital organs of both sexes. Thus, a testicle on one side may co-exist with an ovary and Fallopian tube on the opposite: in these cases an ill-developed uterus is usually found, with an imperforate and small penis, and a fissure terminating in a cul-de-sac beneath it. In other instances, the external organs of the female are comparatively perfect, but the uterus is small or altogether wanting; and, in place of the ovaries, testicles are found, the ducts of which terminate in the uterus or vagina. The free-martin amongst cattle, to the anatomy of which Mr. Hunter directed attention in his *Animal Economy*, belongs to this variety of malformation. The case may be reversed, and the type of the external organs may be that of the male, with the exception of the testicles, whilst the internal organs as strictly belong to the female sex. A further variety involves a greater complexity, in exhibiting a tendency to the repetition of the corresponding organs of both sexes on the same side of the body: as in the co-existence of the uterus and vesiculæ seminales, or the testicles and ovaries. Lastly, cases are on record in which a more or less perfect uterus was superadded to the male genital organs. It is almost unnecessary to remark that, even in these nearer approaches to true hermaphroditism, the varieties alluded to are still widely removed from that normal condition which admits of self or mutual impregnation.

Anatomy.

INDEX TO THE ANATOMY.

SECTION VI.

Organs of Circulation.

SECTION VII.

Organs of Respiration.

SECTION VIII.

Organs of Absorption.

SECTION IX.

Urinary System.

SECTION X.

Organs of Reproduction.

MATERIA MEDICA.

MATERIA MEDICA is that department of the science of medicine which treats of the materials employed for the alleviation and cure of disease. The plan of the present treatise will not allow of our entering into all the botanical and chemical details usually contained in works on the subject of the Materia Medica; nor do these details possess sufficient interest, for the generality of readers, to render it at all desirable that much space should be allotted to them. Those who wish for further information on the botanical part of the subject we would refer to the Article BOTANY. In order to avoid much needless repetition, we shall preface our account of the various articles of the Materia Medica by a brief description of the most important pharmaceutical processes resorted to in the preparation of medicines.

The operations of pharmacy may be arranged in two classes; 1. Mechanical; 2. Chemical.

Under the first head are included the processes of weighing and measuring, and those for the mechanical division and separation of bodies. Those pharmaceutical processes which are purely chemical comprise various operations for the production of changes in the physical or chemical states of bodies, and in the performance of which we call to our aid the agency of water, and of other chemical agents.

MECHANICAL OPERATIONS.

1. *The mode of determining the weight and bulk of bodies.*—The process of weighing is one so simple and so familiar to all as to render unnecessary any account of it in this place. In the compounding of medicines, the British Colleges direct the use of Troy weight. The subjoined Table exhibits the manner in which the pound is divided, and the signs employed for denoting the different weights.

A pound, ℔	contains	Twelve ounces, ℥ xij.
An ounce, ℥		Eight drachms, ʒ viij.
A drachm, ʒ		Three scruples, ℈ iij.
A scruple, ℈		Twenty grains, gr. xx.
A grain, gr.		

For the measure of liquids, the wine gallon is used, which, for medicinal purposes, is thus divided—

A gallon, C.	contains	Eight pints, O viij.
A pint, O.		Twenty fluid ounces, f. ℥ xx.
A fluid ounce, f. ℥		Eight fluid drachms, f. ʒ viij.
A fluid drachm, f. ʒ		Sixty minims, ♏ lx.
A minim, ♏		

The specific gravity of liquids is frequently taken as a measure of their goodness and purity; alcohol, for example, is strong in proportion as its gravity is low; the strength of sulphuric acid, on the contrary, is greater in proportion to its increase of specific gravity. In expressing the specific gravity of solids and liquids, distilled water is taken as the standard. The specific gravity of liquids is generally ascertained by means of the hydrometer; it may also be readily determined by means of a bottle to which a stopper is accurately fitted, and which is made to contain exactly 1000 grains of distilled water: the bottle is counterpoised, filled with the liquid the specific gravity of which we wish to ascertain, and the weight in grains will be the specific gravity of the liquid:—For example, alcohol would be found to weigh 815 grains, sulphuric acid 1845 grains: the specific gravity of alcohol is thus expressed, ·815; that of sulphuric acid thus, 1·845, water being taken as unity. In ascertaining the specific gravity of a liquid, it must be brought by calculation to a temperature of 60°, if the thermometer be above or below that point at the time of performing the experiment.

Mechanical division of bodies.—The cohesion of bodies often presents an obstacle to chemical combination, as well as to their medicinal action in the stomach; and the following mechanical operations are instituted for the purpose of reducing bodies to a state of minute division.

Trituration is performed on a small scale by the rotatory motion of a pestle in a mortar of glass, agate, or Wedgwood ware. On a larger scale, the same operation is performed by means of rollers of stone or of metal, which are made to turn upon each other by machinery. *Levigation* is a similar process to that of trituration; but in the former case the rubbing is assisted by the addition of a liquid which has not the power of dissolving the solid under operation. *Granulation* is employed for the mechanical division of metals: it is effected by melting the substance, and stirring it briskly until it becomes cold, or by pouring the melted metal into water, and agitating until it is cool, or by shaking it in a wooden box, the inside of which has been covered with chalk.

Mechanical separation of bodies is frequently effected by one of the following processes:—sifting, eleutriation, filtration, expression, and despumation. The operation of *sifting* is employed for the separation of the coarser from the finer parts of powders. To effect the same purpose, the process of *eleutriation* is sometimes resorted to in the case of powders which are insoluble in water. The powdered substance is briskly stirred with a large quantity of water, so as to diffuse it equally through the liquid: the finer particles remain suspended, while the coarser fall to the bottom of the vessel. The liquid in which the fine particles are suspended is then poured off, and allowed to remain at rest until the whole of the powder has become deposited; the supernatant liquor is then removed, either by careful decantation, or by an inverted syphon.

Filtration is used for separating fluids from solids, and sometimes for separating one fluid from another with which it is mixed. Thus, suppose we have a mixture of oil of turpentine with water; if we wet the paper filter with water, then pour on the mixture, the whole of the water will pass through, leaving the oil on the filter.

Expression is employed for obtaining the juice of fresh vegetables, and the fixed vegetable oils. The substance is first bruised or coarsely ground, then

enclosed in a hair-cloth bag, and subjected to violent pressure between the plates of a screw-press.

Despumation is employed to clarify liquids which are too viscid to pass through a filter. It is sometimes necessary merely to heat the liquid, which then throws up a scum, that is to be carefully removed; but more commonly it is necessary to use the white of egg; the albumen is coagulated by the heat, it entangles the impurities, and rising with them to the surface, is removed in the form of a scum.

Chemical Operations.

Under the head of chemical operations are arranged all those processes which effect changes in bodies by the agency of heat, or by the action of water, and other chemical agents. Those operations which are performed by the agency of heat alone are—*liquefaction, fusion, evaporation, distillation, rectification,* and *sublimation.* The operations which are performed by means of water and other liquids are—*solution, lixiviation, maceration, digestion, infusion, decoction,* and *extraction.*

The changes produced by the chemical action of one set of bodies upon another are—*decomposition, precipitation,* and *fermentation.*

Liquefaction is that process by which some bodies, when exposed to a moderate heat, are rendered fluid after passing through several intermediate states of softness. This process is adopted for the purpose of rendering fluid such bodies as fat, lard, wax, and resin, and thereby to facilitate their combination in the formation of ointments.

Fusion is a modification of liquefaction, but differs from it in the sudden changes from the solid to the liquid state, which those bodies which are liable to it suffer on exposure to heat. There are no intermediate states of softness; but the fusible body, when heated to a certain point, immediately assumes the liquid form. Fusion is generally confined to the metals, which are extracted from their ores, and afterwards smelted and alloyed by it.

Evaporation is the dissipation of a liquid, in the form of vapour, by means of heat; it is employed in pharmacy when we wish to obtain in the solid form any fixed substance which may be in a state of solution in water, or in any other vaporizable liquid. By this means we obtain a salt from its solution in water. When the process of evaporation is employed, the liquid is entirely dissipated and lost; hence, when the value of a liquid renders its preservation desirable, we have recourse to the process of distillation.

Distillation differs from evaporation in this, that the vapour of the liquid is again condensed and collected in another vessel; the vapour of the liquid in the retort carries off a large amount of latent heat, which is given up to the liquid surrounding the receiver, when the vapour again assumes the liquid form. The common still consists of a boiler which contains the liquid to be acted on; the boiler is surmounted by the head, which is drawn out into a tapering pipe, bent in an arched form, and terminating in the *worm.* The worm is a long pewter pipe, of a decreasing diameter, which winds in a spiral direction obliquely through a deep tub filled with cold water. The vapour arising from the liquid in the boiler is condensed in the worm, and issues in drops from the lower end of the pipe.

Rectification is the repeated distillation of any product obtained by distillation, for the purpose of obtaining it in a state of purity. The second operation is carried on at a lower temperature, so that the more volatile materials only are raised and pass over into the receiver, while the impurities remain in the retort. In the rectification of alcohol and ether, it is usual to put into the retort some substance, such as chloride of calcium, or carbonate of potash, which, by its affinity for the water, restrains it, and prevents its evaporation.

Sublimation is a species of distillation in which the substance acted on is a solid: the vapour arising from the volatilization of the solid is condensed, and reassumes the solid form. This process is employed in the preparation of calomel.

Solution is that process by which the cohesion of a solid is overcome by the attraction of a liquid solvent; in this action, the two forces of homogeneous cohesion and heterogeneous adhesion are opposed to each other; and when the two forces are exactly in equilibrio, the liquid is said to be saturated. Heat increases the solvent power of liquids by opposing cohesion, and at the same time increasing the force of attraction. When a liquid is saturated with one solid, it still retains the power of dissolving a second, and even a third, when saturated with the second; and so on until it holds in solution three, four, or more bodies at the same time.

Lixiviation is a term applied to solution when the substance acted on contains both soluble and insoluble matters. Thus, wood-ashes are lixiviated for the purpose of separating the soluble salts of potash which they contain: on a large scale, it is performed in a tub having a hole near the bottom. A layer of straw is placed near the bottom of the tub, over which the substance is spread and covered by a cloth; after which, cold or hot water, according as the salt is more or less soluble, is poured on. The water takes up the soluble parts, and, gradually filtering through the straw, escapes from the hole at the bottom of the tub.

Maceration is that operation by which the soluble parts of substances, chiefly of a vegetable nature, are obtained in solution by immersing them in *cold* water, or in spirituous fluids.

Digestion is an operation similar to maceration, except that the solvent power of the liquid is aided by a gentle heat.

Infusion is intended for the extraction of the volatile and aromatic principles of vegetables, which would be dissipated by decoction; and also those parts of vegetables which are more readily soluble in water, as gum, sugar, extract, tannin, and the salts. The water is poured boiling hot on the materials sliced or reduced to a coarse powder, and kept in a closely-covered vessel until they are cold, when the infusion is decanted off for use.

Decoction, or boiling, is intended to answer the same purposes as infusion; but in this operation the solvent power of the liquid is increased by the long-continued application of the boiling temperature. Decoction is employed with advantage to extract the mucilaginous parts of plants, their bitterness, and several other of the vegetable principles.

Extraction.—If an infusion or a decoction be subjected to evaporation, the liquid part is evaporated, and the substances dissolved in it are obtained in a solid form, and receive the name of an extract.

Decomposition implies the separation of the component parts of bodies from one another. It may be

produced by heat, or by electricity, but in most cases it is the result of the superior affinity of some chemical agent for one or more of the elements of a compound. When nitric acid is added to carbonate of ammonia, the carbonic acid is displaced by the greater affinity of the stronger acid for the ammonia; nitrate of ammonia is formed, and the carbonic acid escapes with effervescence. This is a case of decomposition by *single elective* affinity. If, instead of adding nitric acid to carbonate of ammonia, we mix a solution of nitrate of lime with one of carbonate of ammonia, we have a case of *double elective affinity*, and *double decomposition* occurs. The carbonic acid leaves the ammonia, and, combining with the lime, forms carbonate of lime, which, being insoluble, falls to the bottom of the vessel; at the same time the nitric acid being transferred from the lime to the ammonia forms nitrate of ammonia, which remains in solution. Many pharmaceutical compounds are prepared by the process of decomposition: and the prescriber must be careful not to associate such substances as decompose each other. For example, if to the compound infusion of roses we add acetate of lead, the sulphuric acid in the infusion combines with the lead, an insoluble sulphate of lead is formed, and the patient, who it might be supposed was taking sulphuric acid and lead, would, in fact, be taking neither the one nor the other.

Precipitation is an operation in which decomposition occurs, a solid substance being thrown down from a liquid in which it was held in solution, by the chemical action of another body which is added to the solution. The substance employed to produce the precipitation is called the *precipitant*, the substance which is separated by its action, the *precipitate*. Thus, if into a solution of sulphate of magnesia a solution of soda be dropped, the magnesia separates from the sulphuric acid, falls to the bottom, and forms the precipitate; while the alkali, which is the precipitant, combining with the acid thus set free, remains in solution in the state of sulphate of soda.

Fermentation. — The constituents of vegetable matter, when separated from the living plant, and placed under certain circumstances, act upon one another, a spontaneous decomposition and metamorphosis occur, and new compounds result. This process has been denominated *Fermentation;* and as its phenomena and results vary according to the nature of the vegetable matter subjected to it, and the circumstances under which it occurs, the general process is divided into different species, easily distinguished from each other. *Diastase* is a remarkable principle, which is produced in the incipient germination of grains and seeds, and the tubers of potatoes; this substance has the power of converting starch into sugar, and the process by which the change is effected is termed the *Saccharine* fermentation. If to a saccharine liquid we add a small quantity of animal albumen, fibrine, or gluten, in a state of putrefaction or spontaneous decomposition, keeping the mixture at a temperature of about 70°, we determine in it the process of what is called the *Vinous fermentation;* carbonic acid gas escapes, and the sugar becomes converted into alcohol. A liquid which has undergone the vinous fermentation, if exposed to the air, is capable of another metamorphosis; the alcohol abstracts oxygen from the air, and becomes converted into acetic acid and water: this is designated the *Acetous fermentation.* Most vegetable substances, when subjected to the influence of air, moisture, and a moderate temperature, undergo the *Putrefactive fermentation;* their elements enter into new combinations, gases having a fœtid odour escape, leaving behind only a small quantity of earthy and metallic matter.

We next proceed to give an account of the various articles of the Materia Medica, and of the most important substances prepared from them. For convenience of reference, we shall arrange them in alphabetical order:—

Abietis resina.—Vide *Pinus abies.*

Absinthium.—Vide *Artemisia Absinthium.*

Acacia.—*Sex. syst. Polygamia. Monœcia. Nat. ord. Leguminosæ.*

1. Acacia Catechu.

The Acacia Catechu, from which the catechu of commerce is obtained, grows in various parts of the East Indies, and is now common in Jamaica. Catechu is obtained by boiling the wood in water; the decoction is then evaporated until the extract is of sufficient consistence to be poured into clay moulds.

Qualities.—There are two varieties of catechu in commerce, the pale and the dark. Pale catechu is generally in small cakes, of a pale reddish-brown colour, light and friable, with a lamellated texture and rough fracture; has a bitterish and astringent taste, leaving a degree of sweetness on the palate; is inodorous, and has a specific gravity between 1·28 and 1·39. The dark variety, which is in round masses, has a deep chocolate colour internally, with the hue of rusty iron on the outside; the texture is uniform, and the fracture resinous, marbled, and shining. It is heavier than the pale, the specific gravity being 1·45, and has a more austere and bitter taste; but in other respects it agrees with the other kind.

Composition.—The following is the analysis of a specimen of each variety, by Sir H. Davy:—

	Dark.	Pale.
Tannin	54·5	48·5
Peculiar extractive	34·0	36·5
Mucilage	6·5	8·0
Insoluble matter (chiefly sand and lime)	5·0	7·0
Catechu	100·0	100·0

Physiological Effects.—Catechu produces the local and general effects of a vegetable astringent.

Uses.—Employed as an astringent in the following cases:—In cases of chronic inflammation of the throat, usually called relaxed sore throat: it may be chewed or sucked. It is occasionally used in the same way by public speakers or singers to prevent hoarseness. As an astringent in diarrhœa, it may be usefully combined with chalk or opium. As an astringent in atonic hæmorrhages, and in cases of gleet and fluor albus. It is also occasionally used as a topical application to flabby ulcers.

Administration.—Dose, grs. x. to ʒ i. It may be given in the form of a bolus, or in the form of infusion or tincture.

Acacia Vera.—This species of Acacia is found in almost every part of Africa, but the tree that yields the gum which is exported from Barbary to Great Britain grows principally in the Atlas mountains. The gum of the Acacia tree flows, in the liquid state, from the trunk and branches, and hardens by exposure to the air. It

usually exudes spontaneously; in some instances, however, the discharge is facilitated by incisions. USES.—Gum is employed in medicine for its nutritive, emollient, and demulcent properties; it is very commonly used as a vehicle for more active medicines. It is sometimes slowly dissolved in the mouth to allay troublesome cough, and to diminish irritation of the fauces. It is used as a demulcent in inflammatory affections of the intestines, as well as of the urinary and respiratory organs. As a vehicle for the exhibition of other medicines, it may be taken *ad libitum* in the form of powder or mucilage.

ACETOSELLA.—Vide *Oxalis Acetosella.*

ACETUM—*Vinegar*—prepared by exciting the acetous fermentation in substances which have undergone or are susceptible of the vinous fermentation. In this country it is prepared from malt, which is mashed with hot water, as in the ordinary operation for brewing. The cooled wort is then transferred to the fermenting tun, where it is mixed with yeast, and undergoes the vinous fermentation. The wash is then introduced into barrels, and a moderate heat is kept up until the acetous fermentation is complete. This process occupies several weeks, or even months. The liquor thus procured is then introduced into large tuns furnished with false bottoms, in which is placed *rape*, the residuary fruit which has served for making domestic wines. These rape-tuns are worked by pairs; one of them is quite filled with vinegar from the barrels, and the other only three-quarters full, so that fermentation is excited more readily in the latter than in the former, and every day a portion of the vinegar is conveyed from one to the other till the whole is completely finished and fit for sale. For a brief explanation of the acetous fermentation, vide p. 497. Vinegar consists of *water*, *acetic acid*, *colouring matter*, a *pecular organic matter* commonly called mucilage, a small portion of *alcohol*, and *a peculiar odorous principle.* Vinegar makers are allowed to add one-thousandth part by weight of sulphuric acid. ADULTERATION.—It sometimes contains an excess of sulphuric acid; hence it is ordered that the sulphate of baryta precipitated when chloride of barium is added to a fluid ounce of vinegar shall not exceed 1·14 grains. EFFECTS.—Vinegar acts as a tonic, refrigerant, diaphoretic, and diuretic; and externally applied it is moderately stimulant and astringent. USES.—It is sometimes used in fevers to acidulate the ordinary beverage, but it is seldom employed alone. Dose, f. ʒ ſs. to f. ʒ iv.

ACETUM DISTILLATUM — *Distilled Vinegar*—prepared by distilling vinegar in a sand-bath from a glass retort into a glass receiver. The seven pints first distilled are kept for use. By distillation the vinegar is freed from its colouring matter and sulphuric acid. It is a mixture of acetic acid, a little alcohol, and water. Thirteen grains of the crystals of carbonate of soda are saturated by 100 grains of distilled vinegar. ADULTERATION.—Sulphuric acid may be detected in it by a precipitate being produced on the addition of chloride of barium. USE.—Chiefly in pharmacy.

ACIDUM ACETICUM—*Acetic Acid*—prepared by adding dilute sulphuric acid to acetate of soda, and distilling from a sand-bath. PROPERTIES.—It is limpid and colourless, its smell is pungent, and its taste acrid. 100 grains saturate 87 grains of crystallized carbonate of soda. A mixture of 15 parts by weight of this acid, and 85 of water, is equal in strength to distilled vinegar. PURITY.—Sulphuric acid may be detected by adding chloride of barium, and metals by the change of colour produced by passing a current of sulphuretted hydrogen through the liquid. EFFECTS.—In the concentrated state, it is an irritant and corrosive poison. Applied to the skin, it acts as a rubefacient and vesicant. In moderate doses it is refrigerant, tonic, diaphoretic, and diuretic. USES.—In small doses, taken as a refrigerant drink in fevers and inflammatory diseases. It is sometimes used as a gargle, and as an external application to ulcers. It is much used in pharmacy. ANTIDOTES.—In cases of poisoning by this, or by any of the strong acids, the antidotes are chalk, whiting, or magnesia suspended in water. In the absence of these, soap-suds, infusion of wood ashes, weak solutions of carbonate of potash or soda, white of eggs, gelatine, milk, oil, or in fact any mild diluent, should be immediately administered.

ACIDUM ARSENIOSUM.—Vide *Arsenicum.*

ACIDUM BENZOICUM—*Benzoic Acid*—obtained from gum benzoin by sublimation. EFFECTS.—Internally, it acts as a stimulating expectorant. When benzoic acid has been taken internally, hippuric acid is found to exist abundantly in the urine. Dr. Ure affirmed that the hippuric acid was formed by the action of benzoic acid on the uric acid in the urine, and he has recommended the use of benzoic acid to dissolve uric acid calculi, *i. e.*, by converting the insoluble uric acid into the soluble hippuric. Liebig, however, states that the hippuric acid is formed from the benzoic acid alone, and that the quantity of urea and uric acid is not lessened by taking benzoic acid.

ACIDUM CITRICUM—*Citric Acid*—obtained from the juice of lemons. Chalk is added to the heated lemon-juice: we thus obtain a citrate of lime, which is then boiled with dilute sulphuric acid; an insoluble sulphate of lime is formed, and the citric acid is poured off with the water, and obtained by evaporation. The crystals are in the form of right rhombic prisms, white and semi-transparent. The taste is extremely acid. EFFECTS.—Small quantities of citric acid dissolved in water allay thirst, diminish preternatural heat, check profuse sweating, and promote the secretion of urine. USES.—Often employed in the preparation of refrigerant drinks, and still more frequently combined with bicarbonate of potash in the formation of the effervescing draught., 14 grains of citric acid will saturate ℈ j. of bicarbonate of potash. Citric acid is frequently used as an anti-scorbutic.

ACIDUM HYDROCHLORICUM—*Hydrochloric or Muriatic Acid*—prepared by adding dilute sulphuric acid to chloride of sodium, and distilling. In this process sulphate of soda is formed, and remains in the retort; the hydrochloric acid distils over, and is condensed with the water in the receiver. Hydrochloric acid gas is composed of one atom of hydrogen and one of chlorine. The acid of the pharmacopœia is an aqueous solution of the gas. It is a limpid colourless liquid, having a specific gravity 1·16. EFFECTS.—In small doses this acid produces the usual effects of a mineral acid; it is tonic, refrigerant, and diuretic, and usually relaxes the bowels. In large doses it acts as an irritant poison. USES.—As a tonic, combined with vegetable bitters, in some malignant fevers. To remove phosphatic deposits from the urine. In some cases of dyspepsia, especially when the urine is alkaline. It has also been used as a tonic in venereal and scrofulous diseases. Externally it may be used as a caustic, or when diluted as a gargle in cases

of ulceration of the mouth and throat. Dose, from five to fifteen minims, properly diluted. The dilute hydrochloric acid is composed of four fluid ounces of the strong acid, and twelve fluid ounces of water; it may be given in doses of from half a fluid drachm to one fluid drachm. Antidotes.—The same as for the Acetic Acid.

Acidum Hydrocyanicum—*Hydrocyanic or Prussic Acid.*—This acid is readily procured from many vegetables, as from bitter almonds, apple-pips, the kernels of peaches, apricots, cherries, plums, and damsons; the flowers of the peach, cherry-laurel, and bird-cherry; the bark of the latter, and the root of the mountain ash. Preparation.—The processes for procuring this acid are numerous, and most of them complicated. We may mention one process directed by the London Pharmacopœia for the extemporaneous preparation of the dilute acid. "Add $48\frac{1}{2}$ grains of cyanide of silver to a fluid ounce of distilled water, mixed with $39\frac{1}{2}$ grains of hydrochloric acid. Shake all these in a well-stoppered phial, and, after a short interval, pour off the clear liquor into another vessel. Keep this for use, the access of light being prevented." In this process an insoluble chloride of silver is formed, and hydrocyanic acid mixed with water is poured off. Qualities.—A colourless transparent liquid, having an odour like that of bitter almonds; its taste is bitter and peculiar. By exposure to air and light, the acid soon undergoes spontaneous decomposition. The acid is directed in the Pharmacopœia to be prepared of such a strength that 100 grains of it will exactly precipitate 12·7 grains of nitrate of silver dissolved in water: the precipitate, which is cyanide of silver, should weigh 10 grains. Hence the dilute acid should consist of real hydrocyanic acid 2·0, water 98·0. Effects.—In small doses this acid relieves certain morbid conditions without producing any evident change in the condition of the general system. If the dose be gradually increased, it gives rise to a bitter but peculiar taste; increased secretion of saliva; frequently nausea; disordered and laborious respiration; pain in the head, giddiness, obscured vision and sleepiness. In poisonous doses, it produces a sudden sensation of giddiness and faintness, succeeded by tetanic convulsions and insensibility; the respiration is difficult, and the odour of the acid is recognized in the breath; the patient may recover rapidly from this state, or it may terminate in death. When a very large dose is taken, the pulse immediately becomes imperceptible, the breathing not obvious, or there may be two or three deep hurried inspirations, insensibility, and death. Convulsions may or may not be present. There are no morbid appearances observed in cases of poisoning by this acid which at all explain its *modus operandi.* It evidently acts powerfully on the nervous system; and so rapid are its remote effects, that it is difficult to account for them by the slow process of absorption; hence many persons have felt constrained to admit that it acts on the nervous centres by an impression produced on the extremities of the nerves with which it is brought into contact. Uses.—This acid is remarkably efficacious in curing some painful affections of the stomach and intestines, which have received the name of *gastrodynia* or *enterodynia.* It is sometimes useful in allaying vomiting and purging. Formerly it was much used in affections of the pulmonary organs, especially in phthisis, hooping-cough, and asthma; at present it is but little employed in such cases, but is occasionally useful in relieving spasmodic cough. It has been used in cases of hysteria, epilepsy, chorea, and tetanus, but without any decided benefit. It is said to have mitigated the symptoms of hydrophobia. Externally.—This acid has been added to lotions for the treatment of irritating cutaneous diseases; when thus used there is some danger of absorption, and the consequent production of constitutional symptoms. Dose, from three to five minims of the dilute acid in any simple vehicle, repeated three or four times a day. Antidotes.—Chlorine water, or solutions of chloride of lime or chloride of soda. Chlorine acts by decomposing the hydrocyanic acid, forming hydrochloric acid, and setting free cyanogen. Ammonia should be given as a stimulant. Cold effusion to the face and chest. Artificial respiration ought never to be omitted, as in most cases the immediate cause of death is obstruction of the respiration.

Acidum Nitricum—*Nitric Acid*—prepared by adding sulphuric acid to nitrate of potash, and distilling. Sulphate of potash remains in the retort, and nitric acid passes over, and is condensed with a minute quantity of water. Properties.—Liquid nitric acid is a colourless or very pale yellow limpid fluid, emitting, when exposed to the air, white suffocating vapours. It is highly corrosive, and tinges the skin yellow, the tint remaining till the epidermis peels off. About 217 grains of the crystals of carbonate of soda are saturated by 100 grains of this acid. Its specific gravity is 1·50. When poured on volatile oils, this acid imparts oxygen to them so rapidly as to set them on fire, and it is capable of oxidizing all the metals.

Acidum Nitricum Dilutum is composed of one fluid ounce of strong acid, and nine fluid ounces of water. Physiological Effects and Uses.—The strong nitric acid applied to the skin acts as a powerful escharotic, and for this purpose is sometimes applied to sloughing and phagedænic ulcers. It is sometimes applied to poisoned wounds, with the object of decomposing the poison. The dilute acid is frequently used as a tonic, and is especially useful in many cases of debility, accompanied with an alkaline state of the urine. It is often given with advantage in cases of secondary syphilis, when mercury is contra-indicated; in scrofulous subjects, for example. Dose.—The dilute acid may be given in doses of from ♏ x. to ♏ xxx., three or four times a day. Antidotes.—The same as for Acetic Acid.

Acidum Oxalicum—*Oxalic Acid.*—This acid exists ready formed in many vegetables. In the leaves of the wood-sorrel it is found combined with potassa. That which is found in the shops is produced artificially, by boiling sugar with nitric acid. The nitric acid gives oxygen to the sugar, converting the hydrogen into water, and the carbon into oxalic acid. The composition of oxalic acid is—carbon two equivalents, oxygen three equivalents. Properties.—The crystals of oxalic acid are flat four-sided prisms. They are white, transparent, have a very acrid sour taste, and redden all the vegetable blues, except indigo. Oxalic acid is distinguished by effecting a white precipitate with lime-water, which is insoluble in an excess of the acid. With a solution of nitrate of silver it gives a white precipitate of oxalate of silver; this precipitated, dried, and heated over a spirit lamp, is dispersed with a feeble detonation. We have been more minute in describing the properties of oxalic acid, in consequence of the serious error, which has frequently been committed, of taking it for sulphate

of magnesia. The acid taste of the former, and the bitter taste of the latter, would sufficiently distinguish them if persons would taste their medicines before swallowing them. PHYSIOLOGICAL EFFECTS AND USES.—Oxalic acid, in small doses, and in a large quantity of water, sweetened with sugar, forms an agreeable cooling beverage in febrile diseases. In large doses it acts as a virulent and rapidly fatal poison. It produces vomiting, frequently of bloody matter, from its action on the stomach, and, soon becoming absorbed, it acts on the nervous system, producing faintness, convulsions, and death. ANTIDOTE.—The best antidote for oxalic acid is chalk, which should be given powdered and suspended in water; an insoluble and inert oxalate of lime is formed, which may then be removed by the exhibition of emetics.

ACIDUM PHOSPHORICUM DILUTUM—*Dilute Phosphoric Acid*—prepared by the action of dilute nitric acid on phosphorus. PROPERTIES.—A colourless inodorous liquid, having an acid taste. EFFECTS AND USES.—It possesses tonic properties, and may be given in all cases in which the mineral acids are indicated; it may be given for a longer time without disordering the stomach. DOSE, from ♏ x. to ♏ xx.

ACIDUM SULPHURICUM—*Sulphuric Acid.*—The process for procuring this acid is too complex to admit of explanation within the prescribed limits of this treatise; we would refer those of our readers who seek for full and accurate information on this or any other subject connected with the Materia Medica, to the admirable and elaborate treatise of Dr. Pereira, on the *Elements of Materia Medica.* PROPERTIES.—Sulphuric acid is a colourless transparent heavy liquid, having the consistence of oil. It has a specific gravity, 1·845. It is highly corrosive, has a great affinity for water, abstracting it from any animal or vegetable tissues with which it comes in contact, and thus producing a charring effect. EFFECTS AND USES.—This acid is a valuable tonic and astringent. It is usually combined with some vegetable tonic, and is most useful in checking profuse perspirations occurring in debilitated and hectic states of the system. In large doses it is a powerful corrosive poison, giving rise to excruciating pain in the stomach and bowels, faintings, feeble pulse, cold sweats, vomiting, difficult deglutition, convulsions, and death. The symptoms in cases of poisoning by all the mineral acids differ in no important particular, and there is this remarkable point,that the vomited matters produce effervescence when brought into contact with chalk or marble.

ACIDUM SULPHURICUM DILUTUM—*Dilute Sulphuric Acid*—is prepared by adding to fourteen ounces and a half of distilled water one ounce and a half of the strong acid. Dose from ♏ x. to ♏ xxx. ANTIDOTES.—The same as for Acetic Acid.

ACIDUM TARTARICUM—*Tartaric Acid*—obtained from the bitartrate of potassa. This salt is boiled with lime and chloride of calcium; an insoluble tartrate of lime is formed, which is then treated in the same manner as the citrate of lime in preparing citric acid. PROPERTIES.—Tartaric acid in its crystalline state is white, imperfectly transparent, very acid, readily soluble in water: at a high temperature it is decomposed into carbonic acid and water. EFFECTS AND USES.—The same as those of Citric Acid.

ACONITUM NAPELLUS—*Monk's Hood.*—*Sex. syst. Polyandria. Trigynia. Nat. ord. Ranunculaceæ.* HAB.—Europe, a doubtful native. PARTS USED, the root and leaves. DESCRIPTION.—Aconite root, when fresh, consists of a tapering root-stock, and of numerous cylindrical fibres arising from it; its colour is externally coffee brown, internally white and fleshy; its taste is bitter, but after a few minutes a remarkable numbness and tingling is perceived on the lips, tongue, and fauces. By drying, the root shrivels and becomes darker coloured; the *leaves*, when chewed, have the same taste, and produce the same feeling of numbness. COMPOSITION.—The most important constituent is the vegetable alkaloid *aconitina*, which is so poisonous that $\frac{1}{50}$th of a grain endangered the life of an individual. EFFECT.—The *topical* effects, when applied to the tongue, have already been mentioned. When small and repeated doses of the root or leaves are taken internally, they cause a sensation of heat, and a tingling in the extremities, and occasionally slight diuresis. In *poisonous* doses, the most remarkable effects are burning and numbness of the lips, mouth, and throat, extending to the stomach, and accompanied with vomiting, pricking, tingling, and numbness of the extremities, coldness and trembling of the limbs, confusion of the senses, with *contraction* of the pupils. USES.—Aconite is seldom used internally; but as a topical remedy, it is most valuable for the relief of neuralgic and rheumatic pains. In some cases the benefit is immediate and permanent; it may be applied in the form of a tincture of the root, or the extract may be made into an ointment with lard. The aconitina may likewise be applied dissolved in alcohol, or mixed with lard. Care must be taken that it be not applied where the skin is abraded. ANTIDOTES.—In the treatment of poisoning by aconite, the stomach must be speedily emptied; wine, ammonia, or brandy should be freely given, and, if necessary, perform artificial respiration.

ACORUS CALAMUS—*The Sweet Flag.*—*Sex. syst. Hexandria. Monogynia. Nat. ord. Acoraceæ.* HAB.—A native of this country, and grows in other countries of Europe, in Asia, and in the United States. PART USED.—The rhizome, or under-ground stem. EFFECTS AND USES.—It is an aromatic stimulant and mild tonic. It is seldom employed, but it is an useful adjunct to other stimulants and tonics. The dried root is used by the country people of Norfolk for the cure of ague. DOSE, ℈j. to ʒj. of the powdered rhizome.

ADEPS PRÆPARATUS—*Prepared Lard.*—Occasionally salt is added to lard to preserve it, but unsalted lard should be used for medical purposes. By melting in boiling water, lard may be deprived of any salt which may have been combined with it. USES.—Lard is chiefly employed as the basis of ointments; it is sometimes used as a substitute for spermaceti ointment to dress blisters; but the salt which lard frequently contains, as well as the facility with which this fat becomes rancid, are objections to its use.

ALLIUM.—*Sex. syst. Hexandria. Monogynia. Nat. ord. Liliaceæ.*—Two species of allium are used in medicine.

ALLIUM PORRUM—*The Leek.* PART USED.—The bulb. EFFECTS AND USES.—The leek is a stimulant and diuretic in ascites and other forms of dropsy.

ALLIUM SATIVUM—*The Garlic.* PART USED.—The bulb. EFFECTS AND USES.—Garlic is a local irritant. Internally it acts as a tonic, stimulant, diuretic, expectorant, and in large doses, emetic. It is sometimes used as a diuretic in dropsies, and as an expectorant in chronic catarrh.

ALOE—*The Aloe.*—*Sex. syst. Hexandria. Mono-*

gynia. Nat. ord. Liliaceæ. Part used.—The inspissated juice of the leaves. The aloes of commerce is the produce of the *aloe vulgaris* and *aloe spicata.* Hab.—East and West Indies, and the Cape. Preparation.—The finest kind of aloes is obtained by evaporating the juice which flows spontaneously from the transversely-cut leaves. If pressure be employed, the proper aloetic juice becomes mixed with the mucilaginous liquid of the leaves, and thus an inferior kind of aloes is obtained. A still commoner variety is obtained by boiling the leaves in water. Varieties.—There are several varieties of aloes which have received the names of the places in which they are produced: of these the most important are the Socotorine, the Barbadoes, and the Cape aloes. The general appearances and properties of aloes are sufficiently well known to most persons; the distinction between the different varieties is of too little importance to occupy our attention in this treatise. Composition.—The analysis of aloes is far from being satisfactory. We are told that it contains a peculiar extractive matter, called *aloesin, aloetic acid*, and resin. Effects.—In small doses aloes act as a tonic to the alimentary canal, strengthening the muscular fibre, and assisting the digestive process. In large doses it acts as a purgative. The peculiarities attending the purgative operation of aloes are, 1st, its slow action; 2ndly, its acting especially on the large intestines; 3rdly, the power assigned to it of increasing the flow of bile. It is supposed to stimulate the uterus, thus tending to bring on or increase the menstrual discharge. Uses.—Aloes is used in cases of dyspepsia, in habitual costiveness, in cerebral affections to produce a revulsive effect as an anthelmintic, and to excite the menstrual discharge. It is an objectionable purgative when there is a tendency to hæmorrhoids, or to menorrhagia. Dose.—The ordinary dose of aloes is grs. x., but from grs. x. to grs. xx. are sometimes given. On account of its nauseous taste, it is commonly given in the form of pills. Aloes enters into the composition of many preparations of the Pharmacopœia. The *Pilula Aloes compositæ* contains aloes and extract of gentian, and is an useful tonic purgative in doses of from grs. v. to grs. xv. *Decoctum Aloes compositum* contains aloes, myrrh, and carbonate of potash. It is a valuable antacid and stomachic aperient. Dose, ℥ j. There are numerous other preparations of aloes, a knowledge of which may best be acquired by reference to the Pharmacopœia.

Althæa Officinalis—*Marsh Mallow.—Sex. syst. Monadelphia. Polyandria.—Nat. ord. Malvaceæ.* Hab.—Indigenous. Part used.—The root. Effects and Uses.—The root contains a large proportion of mucilage, and is used as a demulcent. The *Syrupus Althææ* is used as an adjunct to cough mixtures, and as a pectoral for children.

Alumen—*Alum.*—This salt is a compound of alumina, potassa, and sulphuric acid. Preparation.—The most extensive alum manufactory in Great Britain is at Hurlett, near Paisley. Here the aluminous schist (which is composed of sulphuret of iron and alumina) lies between the stratum of coal and limestone. By the action of the air it undergoes decomposition, and falls down on the floor of the mine. The sulphur attracts oxygen, and is converted into sulphuric acid, which combines partly with the iron (oxidized by the air) and partly with the alumina. The solution obtained by lixiviating the decomposed schist is evaporated, and the sulphate of iron allowed to crystalize: to the mother liquor, which contains sulphate of alumina, sulphate of potash is added, by which crystals of alum are procured. Composition.—Crystallized alum has the following composition:—Alumina, 3 eq., potassa, 1 eq., sulphuric acid, 4 eq., water, 25 eq. It crystallizes in regular octahedrons. Effects.—The topical effect of alum is that of an astringent, namely:—corrugation of the fibres, and contraction of the small vessels; hence it produces paleness of the parts, and checks exhalation and secretion. Internally it produces dryness of the mouth and throat, increases thirst, checks the secretions of the alimentary canal, and produces constipation. In large doses it acts as an irritant, and produces vomiting and purging. Uses.—Alum is used as a gargle for relaxed sore throat, to produce contraction or corrugation in cases of prolapsus ani. An injection is frequently used to check discharges from the mucous membranes, as in gonorrhœa and gleet. As a styptic, to constringe the capillary vessels, and close their bleeding orifices. As an internal remedy, it is given to restrain passive hæmorrhages, and to check profuse perspiration, or diarrhœa. It is said to have been very successful in the treatment of lead colic. Dose, from grs. x. to ʒ ſs. Antidote.—Where an over-dose of alum has been taken, the best treatment is to promote vomiting by the free use of tepid diluents.

Ammoniæ Hydrochloras—*Hydrochlorate* or *Muriate of Ammonia.* Preparation.—Bones are subjected to the destructive distillation, and the volatile products are condensed in a cooled receiver. In this process various compounds are formed by the combination of the different gases. Thus we have carbon and oxygen uniting to form carbonic acid, which unites with the ammonia formed by the combination of nitrogen and hydrogen; and thus we obtain carbonate of ammonia. The carbonate is converted into sulphate of ammonia by adding sulphuric acid, or by digesting with sulphate of lime. The sulphate of ammonia is then mixed with chloride of sodium, and subjected to sublimation. Sulphate of soda remains in the retort, and hydrochlorate of ammonia sublimes. Properties.—This salt occurs in large translucent cakes; when heated it sublimes; mixed with potash or lime, it gives off ammoniacal gas. Composition.—Hydrochloric acid, 1 eq., ammonia, 1 eq. Effects.—Taken internally, it acts as a diuretic, and the Germans consider it a powerful alterative and resolvent. Uses.—It is seldom used in this country. In Germany it is used in cases of inflammation of the mucous and serous membranes, and in chronic visceral disease. Dr. Watson has frequently given it with success in cases of face-ache.—*Vide Med. Gaz.* vol. 28, p. 489. Externally, it is frequently employed on account of the cold produced during solution in cases of headache, mania, &c. Dose.—For internal uses, the dose is from grs. v. to ʒ ſs., every four or five hours.

Liquor Ammoniæ—*Solution of Ammonia.* Preparation.—Put lime slaked with water into a retort, then add hydrochlorate of ammonia with water; let the solution of ammonia distil. In this process we have formed water, chloride of calcium, and ammoniacal gas, which is dissolved by, and distilled with, the water. Properties.—A colourless liquid, having a very pungent odour, and a caustic alkaline taste; prepared according to the London Pharmacopœia, its sp. gr. is 0·960. Effects.—In the concentrated form, the

local action of liquor ammoniæ is that of an energetic caustic. Its vapours are very irritant, and when applied to the nostril, frequently rouse a person from the most death-like syncope. It should not be incautiously applied, as it may produce dangerous or even fatal inflammation of the larynx. Swallowed in large doses, it acts as a powerfully corrosive poison. The *remote effects* are a sensation of warmth, increased heat of skin, with a tendency to perspiration, and increased quickness of the pulse. There is increased secretion from the bronchial and urinary mucous membranes; the nervous system is also affected. There is increased capability of muscular exertion, and some excitement of the mental functions; these effects soon subside. USES.—To neutralize acidity in dyspepsia. Neither this nor any other alkali should be long continued, as it tends to render the urine alkaline, and favours the deposition of the phosphates, besides interfering with the digestive process by neutralizing the free acids of the stomach. Liquor ammoniæ is frequently used as a rubefacient and counter-irritant in cases of inflammatory sore throat, &c.: for this purpose there is a liniment of ammonia. It is sometimes applied to the surface of the chest, for the purpose of exciting the muscles of respiration in a case of asphyxia. It is given internally as a stimulant in a variety of cases where we wish to produce speedy excitement; for example, in fevers, syncope, poisoning by tobacco, foxglove, &c. DOSE.—From ♏ v. to ♏ xxx., properly diluted. ANTIDOTES.—The dilute acids, as vinegar, lemon, or orange juice: if these be not at hand, the dilute mineral acids, or oil in considerable quantities.

AMMONIÆ SESQUI-CARBONAS—*Sesqui-carbonate of Ammonia.* PREPARATION.—Hydrochlorate of ammonia and chalk are powdered, then mixed, and, with a heat gradually raised, sublimed. The carbonic acid leaves the lime, and combines with the ammonia; while the hydrochloric acid combines with the lime to form chloride of calcium and water. PROPERTIES.—Sesqui-carbonate of ammonia is in colourless translucent masses of a striated crystalline appearance; the smell is pungent, and taste sharp and penetrating. COMPOSITION.—1 eq. ammonia, $1\frac{1}{2}$ eq. carbonic acid, 2 eqs. water. EFFECTS AND USES.—The same as those of the liquor ammoniæ; it is, however, a much less powerful caustic than the liquor ammoniæ. DOSE.—As a stimulant and diaphoretic, from grs. v. to grs. x.; as an emetic, the dose is grs. xxx. ANTIDOTES.—The same as for the liquor ammoniæ.

LIQUOR AMMONIÆ ACETATIS—*Solution of Acetate of Ammonia*—prepared by saturating sesqui-carbonate of ammonia with distilled vinegar. PROPERTIES.—It should be colourless, and should affect neither litmus, nor turmeric. EFFECTS.—It is a mild diuretic and diaphoretic. USES.—It is given in febrile and inflamatory diseases, and forms a constituent of the ordinary saline draught. Externally, it is frequently used mixed with water, as an evaporating lotion to bruised and inflamed parts. DOSE.—f. ℥ fs. to f. ℥ ij. every four hours.

There are three preparations called respectively—SPIRITUS AMMONIÆ, SPIRITUS AMMONIÆ AROMATICUS, and SPIRITUS AMMONIÆ FŒTIDUS.—Each of these contains the *carbonate of ammonia*, formed by the action of hydrochlorate of ammonia, or carbonate of potash. The aromatic spirit contains some cloves, cinnamon, and lemon-peel. The fœtid spirit contains assafœtida. Each of these preparations is stimulant and anti-spasmodic in doses of from ♏ x. to ♏ xl.

AMMONIACUM.—Vide *Dorema Ammoniacum.*

AMYGDALUS COMMUNIS—*The common Almond.—Sex. syst. Icosandria. Monogynia. Nat. ord. Amygdaleæ.* HAB.—The almond-tree is a native of Syria and Barbary; but it is now naturalized in the South of Europe, and even in England, where, however, the fruit seldom ripens. There are two varieties of the almond, distinguished from each other by the taste of the kernel of their fruit. The *sweet* almond has a sweet and bland taste, and contains a large proportion of fixed oil, with some gum, sugar, and albumen. The *bitter* almond contains less fixed oil and more albumen than the sweet almond. a volatile oil, and a portion of hydrocyanic acid. The volatile oil of bitter almonds, which contains hydrocyanic acid, is prepared from the cake remaining after the expression of the fixed oil, by submitting it to distillation with water. Neither the volatile oil nor the hydrocyanic acid pre-exist in the bitter almond: both are developed by the action of water and *emulsin* upon *amygdalin.* EFFECTS AND USES.—Sweet almonds, when triturated with water, form an emulsion which is used as an agreeable vehicle for more active medicines. The oil may be used for the same purposes as olive oil. *Bitter* almonds, in small quantities, act as irritants, causing vomiting and purging; in large doses, tremors, convulsions, insensibility, and death,—the effects arising from the presence of hydrocyanic acid. The volatile oil is a most potent poison, acting as rapidly and giving rise to the same symptoms as the ordinary hydrocyanic acid of the shops. The principal consumption of the bitter almond is by the cook and confectioner for flavouring and scenting. The employment of the oil for such purposes requires great caution, and is not unattended with danger. The oil is much used for scenting soap, and for other purposes of the perfumer. Bitter almonds are seldom employed by the medical practitioner, on account of the uncertainty of their composition and effects. They are applicable to all the uses of hydrocyanic acid. The volatile oil may be given in doses of a quarter of a drop to a drop and a half, in an emulsion. Its strength is variable, but in general it is at least four times that of the officinal acid. ANTIDOTES.—In a case of poisoning by the bitter almond, the treatment must be the same as for hydrocyanic acid.

ANETHUM GRAVEOLENS—*The Dill.—Sex. syst. Pentandria. Digynia. Nat. ord. Umbelliferæ.* HAB.—The dill is a native of Spain and Portugal, and is cultivated in this country. The seeds are the parts used in medicine; they are oval, concave on one side, convex and striated on the other, of a brown colour, and surrounded by a straw-coloured membranous expansion. They have an aromatic odour, and a warm and pungent taste; their properties depend on the volatile oil which they contain. EFFECTS AND USES.—Dill seeds are carminative and stomachic. They are useful in the treatment of flatulent colic in infants. DOSE.—The powdered seed may be given in doses of from grs. x. to ℈j.

ANISUM.—Vide *Pimpinella Anisum.*

ANTHEMIS NOBILIS—*Common Chamomile.—Sex. syst. Syngenesia. Superflua. Nat. ord. Compositæ.* HAB.—The chamomile is indigenous. The flowers are the parts used in medicine: they have a strong and peculiar odour, and a bitter aromatic tase. COMPOSITION.—The chamomile flowers contain volatile oil, bitter extractive, and tannic acid. EFFECTS AND USES.—Chamomiles are

aromatic tonics, increasing the appetite, and assisting digestion. In large doses they act as an emetic. DOSE. —In powder grs. x. to ℈j. The infusion is the most convenient mode of administering them, in doses of from f. ℥i. to f. ℥ij.

ANTIMONII POTASSIO-TARTRAS—*Potassio-tartrate of Antimony.* —This salt is known by the common name of *tartar-emetic.* The details of the preparation of this, as of the other salts of antimony, are so complex as to be quite unintelligible without a lengthened description and the use of diagrams; as our limits will not allow of our entering into these details, we must refer our readers to Dr. Pereira's work on *Materia Medica*, or to Mr. Phillip's *Translation of the Pharmacopœia Londinensis.* We must content ourselves with the general statement, that this salt is formed by boiling the sesqui-oxide of antimony with the bitartrate of potassa. The water is then evaporated, and we obtain crystals of potassio-tartrate of antimony, which is a double salt, composed of one equivalent of tartrate of potash, one equivalent of bitartrate of antimony, with three equivalents of water. PROPERTIES.—Emetic tartar crystallizes in white, transparent, inodorous, rhombic octahedrons, whose lateral planes are striated. They dissolve in 14 or 15 parts of water at 60°.

CHEMICAL CHARACTERISTICS.—Heated in a porcelain or glass capsule it chars, showing it contains an organic substance (tartaric acid). If a stream of hydro-sulphuric acid gas be transmitted through a watery solution of emetic tartar, the latter becomes orange-red; if a small quantity of hydrochloric acid be then added, a flocculent orange-red precipitate (hydrated sesqui-sulphuret of antimony) takes place. This precipitate is to be collected and dried, and introduced into a green glass tube. Then transmit a current of hydrogen gas over it, and after a few minutes apply the heat of a spirit-lamp to the sesqui-sulphuret, and hydro-sulphuric acid and metallic antimony are produced. This metal is known to be antimony by dissolving it in nitro-hydrochloric acid: the solution forms a white precipitate on the addition of water, and an orange-red one with hydro-sulphuric acid gas. PURITY.—The crystals should be well formed, colourless, transparent, or opaque, and when dropped into a solution of hydrosulphuric acid have an orange-coloured deposit formed on them. Emetic-tartar is sometimes adulterated with bitartrate of potash. In order to detect this, a few drops of a solution of carbonate of soda are to be added to a boiling solution of tartar-emetic, and if the precipitate formed be not re-dissolved, we may conclude there is no bitartrate present. EFFECTS.—Applied to the skin in solution, or in the form of ointment, tartar-emetic produces an eruption of painful pustules very much resembling those of small-pox. *Internally*, in small doses, it increases the secretions of the gastro-enteritic mucous membrane, and of the liver and pancreas. Subsequently it acts powerfully on other emunctories: thus it causes sweating without any very evident vascular excitement; it renders the bronchial mucous membrane moister, and, when the skin is kept cool, promotes the secretion of urine. In larger doses it excites nausea, frequently with vomiting, depresses the nervous functions, relaxes the tissues (especially the muscular fibres), and occasions a feeling of great exhaustion. These symptoms are attended by increased secretion, especially from the skin. In excessive doses it has, in a few cases, acted as an irritant poison, and even produced death. A curious fact connected with this medicine is the large doses which are borne without any very obvious effects in many inflammatory diseases. In cases of pneumonia, many grains have been given in the course of 24 hours, without any other effect, after the first two or three doses, than the mitigation of the disease.

USE.—As an emetic, either alone or combined with ipecacuanha, when, in addition to the evacuation of the stomach, we are desirous of making a powerful impression on the system, whereby we hope to arrest some morbid process which may be going on. With this view it is given in the early stage of some fevers and inflammations, especially in croup, quinsy, swelled testicle, and bubo. As a *nauseant* it is frequently given to assist the reduction of dislocations of the larger joints in muscular subjects. It is also most valuable in the treatment of many inflammations, particularly those of the chest, and most especially those of the lungs. It is a most valuable sudorific in febrile and inflammatory diseases generally. As a local irritant it is used in chronic diseases of the chest and of the joints. DOSE.—As a diaphoretic and expectorant, $\frac{1}{12}$ to $\frac{1}{6}$ of a grain: as a nauseant from $\frac{1}{4}$ to $\frac{1}{2}$ grain; as an emetic from 1 to 2 grains; as an antiphlogistic, from $\frac{1}{2}$ a grain to 3 or 4 grains. ANTIDOTE.—Promote vomiting by the copious use of tepid bland drinks.

ANTIMONII OXY-SULPHURETUM — *Oxy-sulphuret of Antimony.*—This is a compound of sesqui-oxide and sesqui-sulphuret of antimony. EFFECTS.—The same as those of tartar-emetic, but more uncertain. It is a constituent of the celebrated Plummer's pill, in which it is combined with calomel and guaiacum. DOSE.—As a diaphoretic and alterative, from gr. j. to gr. iv.

PULVIS ANTIMONII COMPOSITUS—*Compound Powder of Antimony.*—This is a more uncertain preparation than the last. It sometimes acts most violently, and in other cases is quite inert. According to Phillips, it is composed of antimonious acid and phosphate of lime. DOSE, grs. v. to grs. x.; it is but little employed.

ARCTOSTAPHYLOS UVA-URSI—*The Bear-berry.—Sex. syst. Decandria. Monogynia. Nat. ord. Ericaceæ.*—This plant is indigenous. The dried leaves are of a dark, shining green colour, and have a bitter astringent taste, but no odour. They contain tannic and gallic acid in considerable quantities. EFFECTS AND USES.—Uva-ursi is an astringent and tonic, but it has an especial action on the urinary organs; it slightly increases the quantity of the renal secretion, and has the power of checking excessive secretion from the mucous membrane of the bladder. It is chiefly used in chronic affections of the bladder, attended with increased secretion of mucus, and unaccompanied with marks of active inflammation. DOSE.—The powder may be given in doses of from ℈j. to ʒj. It is best given in the form of decoction or extract.

ARGENTI NITRAS—*Nitrate of Silver.*—PREPARATION.—Silver is dissolved in nitric acid; the solution is afterwards evaporated to dryness, and the dried nitrate fused and poured into proper moulds. CHEMICAL CHARACTERS.—It is known to be a nitrate by its deflagration when heated on charcoal, and the evolution of nitrous fumes. Dissolved in water it gives a white precipitate, with hydrochloric acid; this precipitate, by exposure to the light, becomes violet-coloured; it is insoluble in boiling nitric acid, but readily soluble in solution of ammonia. Oxalic acid gives a white preci-

pitate with nitrate of silver; this precipitate, when dried and moderately heated, detonates.

Effects.—Its local action is that of a caustic; it combines and forms insoluble compounds with albumen and fibrin; these are at first white, but afterwards become dark, and even black from the reduction of the silver. Internally administered, it is supposed to have a tonic and anti-spasmodic power, on account of the relief afforded by its use in some spasmodic diseases. One fact must never be lost sight of,—that when this medicine is given internally for a number of weeks, it becomes absorbed, and occasionally produces a blue colour of the skin, the metal becoming reduced by the action of light. Uses.—It is said to have been more successful than any other remedy in the cure of epilepsy; but in most cases it entirely fails. It has been used with success in chorea. Its use as an external agent is more common and more valuable. It is used for destroying warts, and to repress spongy granulations. It is applied to chancres, on their first appearance, to decompose the syphilitic virus, and thus to prevent its absorption. It is applied to poisoned wounds. In some diseases of the eye it is used either in the solid form or in solution. It is used as an injection in gonorrhœa, gleet, and leucorrhœa, and in a number of other cases which we need not now enumerate. Dose.—Nitrate of silver may be given internally in doses of from $\frac{1}{6}$ of a grain to iij. grs. three times a-day: on account of the danger of blackening the skin, its use should not be continued for more than a month or six weeks at a time. For external use a solution is employed, varying in strength from $\frac{1}{4}$ gr. to ℈ ij. in an ounce of distilled water. Antidote.—The antidote for nitrate of silver is common salt (chloride of sodium), which forms with it an insoluble chloride of silver.

Argenti Cyanidum — *Cyanide of Silver*. Preparation.—Dilute hydrocyanic acid is added to a solution of nitrate of silver, the cyanide of silver becomes precipitated. Use.—It is used only for the extemporaneous preparation of hydrocyanic acid. — Vide *Acid hydrocyanicum*.

Aristolochia Serpentaria—*Virginia Snake-Root.* —*Sex. syst. Gynandria. Hexandria. Nat. ord. Aristolochiaceæ.* Hab.—North America. Parts used.—The root. Properties.—The dried root has an aromatic odour, and a warm bitter pungent taste, which depends on the presence of a volatile oil. Effects and Uses.—It is a stimulating diaphoretic and tonic; and is sometimes, but rarely, employed as a stimulant in continued and intermittent fevers. Dose, grs. x. to ʒ j. The infusion is the best form for its administration.

Armoraciæ Radix.—Vide *Cochlearia Armoracia*.

Arsenicum—*Arsenic.*—The compound of arsenic which is used in medicine is the arsenious acid. It is obtained by sublimation from a compound of arsenicum, iron, and sulphur. The arsenic becomes volatilized, and combining with the oxygen of the air is condensed again in the form of arsenious acid. Composition.—Arsenious acid is composed of one equivalent of arsenic, and one and a half equivalent of oxygen. Properties.—When recently prepared, arsenious acid is in the form of large, glassy, transparent cakes, sometimes colourless, at others having a yellowish tinge. Sp. gr. about 3·7. Sparingly soluble in cold water, more abundantly soluble in boiling water. It is soluble in alcohol and oils. At a temperature of 380° Fahrenheit it volatilizes. Chemical Characteristics.—*Solid arsenious acid* is recognized by the following characters: 1st *its volatility*. 2nd. *Garlic odour.*—If arsenious acid be put on a red-hot cinder, it evolves a scarcely visible vapour (of metallic arsenicum) having a garlic odour, and which, at the distance of an inch or two from the cinder, is converted into a dense white colourless mass (arsenious acid). 3rd, *Formation of a metallic crust (reduction test).*—If arsenious acid be mixed with freshly ignited but cold charcoal, and heated in a glass tube, the acid is deoxidized, and yields arsenicum, which sublimes into the cooler portion of the tube, where it condenses and forms a metallic crust. The characters of the arsenical crust are the brilliancy of its outer surface; the crystalline appearance and greyish white colour of its inner surface; its volatility; its conversion by sublimation, up and down the tube, into octahedral crystals of arsenious acid, which may be dissolved in distilled water, and tested by the liquid re-agents presently to be mentioned.

Characters of an aqueous Solution of Arsenious Acid.

1. *Ammoniaco Sulphate of Copper.*—A dilute solution of this gives, with arsenious acid, a pale green precipitate (arsenite of copper), and sulphate of ammonia remains in solution. 2. *Ammoniaco-Nitrate of Silver* gives a yellow precipitate of arsenite of silver, and nitrate of ammonia remains in solution. 3. *Sulphuretted Hydrogen Gas* passed through a solution of arsenious acid gives a yellow precipitate of sesqui-sulphuret of arsenicum. 5. *Nascent Hydrogen.*—If arsenious acid be submitted to the action of nascent hydrogen, it is deoxidized, and the metallic arsenicum, thus produced, combines with the hydrogen and forms arseniuretted hydrogen gas. This gas is recognized by its alliaceous odour, by burning in the air with a bluish-white flame, and the deposition of black metallic arsenicum and white arsenious acid. Such is an outline of the characters of arsenious acid; but there are numerous fallacies, impediments, and precautions to be attended to in testing for this substance, for the details of which we would refer our readers to Dr. Christison's admirable work on *Poisons*. Effects.—In very small doses arsenic relieves some diseases of the skin and nervous system without producing any other obvious effect on the functions of the body. If the small doses be long continued, symptoms of slow poisoning appear, commencing with thirst, redness of the conjunctiva and eyelids, disorder of the digestive functions, flatulence, pain in the abdomen, nausea, vomiting, sometimes purging: in some cases salivation occurs, quick pulse, hot skin, headache; sometimes an eruption appears on the skin; under these symptoms the patient may gradually sink. *In excessive doses* the symptoms are usually those of violent inflammation of the stomach and intestines pain, vomiting, and purging, with rapid sinking of the vital powers; symptoms of disorder of the nervous system usually precede death. In some cases, when very large quantities have been taken, death has occurred rapidly, with symptoms of *narcotism*, and without any marked symptoms of abdominal inflammation. In cases of poisoning by arsenic, the *post-mortem* appearances are chiefly those indicative of inflammation of the stomach and intestines.

Arsenious acid has the power of preventing or retarding the putrefactive process; hence the good state of preservation in which the alimentary canal has been found some months after death in persons poisoned by this substance. Uses.—Arsenious acid is a valuable

remedy in intermittent fevers, and in various chronic affections of the skin, particularly the scaly diseases (lepra and psoriasis). It has been used in some nervous diseases, as epilepsy and chorea, but with doubtful advantage. It is sometimes used as an external application to malignant ulcers, &c.; but this mode of using it has occasionally been followed by fatal consequences. Dose, gr. $\frac{1}{16}$ to gr. $\frac{1}{8}$, in a pill, with crumb of bread: the best mode of administering it is in the form of the *Liquor Potassæ Arsenitis*, the dose of which is ♏ v. gradually and cautiously increased. Antidotes.—Empty the stomach by the pump, or by an emetic of sulphate of zinc or sulphate of copper; promote vomiting by tepid and demulcent drinks; as milk, white of egg, and water-gruel, &c. Hydrated sesquioxide of iron has been proposed as an antidote; it must be given in very large doses.

Artemisia Absinthium—*Common Wormwood.—Sex. syst. Syngenesia. Polygamia. Superflua. Nat. ord. Compositæ.* Hab.—Indigenous. Parts used.—The tops. Composition.—Volatile oil and a bitter principle. Effects and Uses.—It is an aromatic tonic, and is said to be vermifuge, but it is seldom employed.

Asarum Europæum—*Asarabacca.—Sex. syst. Dodecandria. Monogynia. Nat. ord. Aristolochiaceæ.* Hab.—Indigenous. Part used.—The leaves. Composition.—Volatile oil, asarite, *camphor*, and a *bitter principle.* Effects and Uses.—Every part of the plant is very acrid; applied to the nose it excites sneezing, and an increased flood of mucus; swallowed, it excites vomiting and purging. It has sometimes been used as an *errhine*, three or four grains of the powdered leaves being snuffed up the nostril every night.

Assafœtida.—Vide *Ferula Assafœtida.*

Aspidium Filix Mas—*The Male Fern.—Sex. syst. Cryptogamia Filices, Nat. ord. Filices.* Hab.—Indigenous. Part used.—The rhizome. Composition.—Its anthelmintic propertydepends on a peculiar oil, which is soluble in ether. Effects and Uses.—It is employed only as an anthelmintic, and is not a remedy of much value. Dose.—Of powder from ʒ j. to ʒ iij. The oil may be given in the dose of from f. ʒ ſs. to f. ʒ j.

Astragalus Verus—*Tragacanth.—Sex. syst. Diadelphia. Decandria. Nat. ord. Leguminosæ.* Hab.—Asia. Tragacanth is a natural exudation from the stem of the plant. Composition.—Soluble and insoluble gum and starch. Effects.—Emollient, demulcent, and nutritive. Uses.—As a vehicle for more active medicines, and as a sheathing or demulcent agent in irritation of the mucous membranes.

Atropa Belladonna—*Deadly Night-shade.—Sex. syst. Pentandria. Monogynia. Nat. ord. Solanaceæ.* Hab.—Indigenous. Part used.—Leaves and root. Composition.—Its properties depend on an alkaloid called *Atropia.* Effects.—In small doses belladonna diminishes sensibility and irritability. In the *second degree* of its operation it causes dilatation of the pupils, dimness of sight, numbness of the face, confusion of the head, and delirium, which at times resembles intoxication, and may be combined with, or followed by torpor. There is dryness of the throat, and difficulty of swallowing, and of articulation; the mucous secretions are frequently increased; an eruption like that of scarlet fever has been noticed. In the *third degree* of its operation, belladonna produces effects similar to the preceding, but in a more violent form; when applied to the eyebrow, belladonna produces dilatation of the pupil. Uses.—To allay pain and nervous irritation, to relieve spasm, to produce dilatation of the pupil in diseases of the eye, to resolve tumors. By the homœopathist, it has been used as a prophylactic against scarlatina. Dose.—The *powder* may be given in one-grain doses. The *extract* is prepared by bruising the fresh leaves, sprinkled with a little water, in a stone mortar; then press out the juice and evaporate it, unstrained, to a proper consistence. Dose.—gr. j. to grs. v. The extract is often useful, when locally applied, in relieving rheumatic and neuralgic pains. Antidotes.—Similar to those for opium.

Balsamodendron Myrrha—*The Myrrh Tree.—Sex. syst. Octandria. Monogynia. Nat ord. Terebinthaceæ.* Hab.—Gison, on the borders of Arabia Felix. Myrrh exudes from the bark of the tree: it is at first soft, and of a yellow colour, but, by drying, becomes darker and redder. Composition.—The chief constituents of myrrh are volatile oil, resin, and gum. Effects and Uses.—Myrrh is an aromatic stimulant and tonic; it has been supposed to have a specific stimulant operation on the uterus, and hence has been called emmenagogue. It is given in cases of debility, amenorrhœa, and chlorosis, and in certain stages of phthisis. Dose—grs. x. to ʒ ſs. Myrrh is a constituent of several pharmacopœial preparations.

Balsamum Peruvium—Vide *Myrospermum Peruiferum.*

Balsamum Tolutanum—Vide *Myrospermum Toluiferum.*

Barytæ Carbonas—*Carbonate of Baryta.*—This salt is found native. Use.—It is not used as a medicine, but is employed in the preparation of the chloride of barium.

Barii Chloridum—*Chloride of Barium.* Preparation.—Add dilute hydrochloric acid to carbonate of baryta, apply heat, and when the effervescence has ceased, strain and boil down, that crystals may form. Characteristics.—The salts of baryta give, with sulphuric acid, a white precipitate, insoluble in water and in nitric acid. Composition.—1 eq. barium, 1 eq. chlorine, with which are combined in the crystals 2 eq. water. Effects.—In small doses chloride of barium increases the secretion of urine and of perspiration, and at the same time glandular swellings sometimes become softer and smaller. In larger doses it produces nausea and vomiting, and in excessive doses it acts strongly on the nervous system, producing headache, convulsions, and death within an hour. Use.—It has been chiefly used in the treatment of scrofula. Dose.—It is used in the form of aqueous solution. The *liquor barii chloridi* consists of a drachm of the salt in an ounce of water; the dose is ♏ x. In chemistry this salt is used as a test for sulphuric acid and the sulphates. Antidotes.—The sulphates, which form an insoluble sulphate of baryta.

Belladonna.—Vide *Atropa Belladonna.*

Benzoinum.—Vide *Styrax Benzoin.*

Bistorta.—Vide *Polygonum Bistorta.*

Bismuthi Trisnitras—*Trisnitrate of Bismuth*—prepared by dissolving bismuth in nitric acid: water is then added, and the trisnitrate precipitates. Composition.—3 eqs. of oxide of bismuth and 1 eq. of nitric acid. Effects.—In small doses it acts as an astringent; it is supposed to have a sedative effect on the nerves of the stomach; it has also been considered tonic and anti-spasmodic. In large doses it is poisonous. Use.

—Its chief use is to relieve gastrodynia and cramp of the stomach, to allay sickness and vomiting, and as a remedy for the water-brash. Dose, grs. v. to ℈ j., in the form of a pill.

Brominium—*Bromine*. Preparation.—It is prepared from the mother liquor of some springs, which contain the bromide of potassium in solution: binoxide of manganese and hydrochloric acid are added, and heat applied, the bromine is set free, and distils over. Properties.—At ordinary temperatures, bromine is a very volatile liquid, which, seen by reflected light, is blackish red, but by transmitted light is hyacinth red. Its odour is strong and taste acrid. It communicates a fine orange-colour to starch. Effects.—Bromine stains the cuticle yellowish brown, and acts as an irritant. Its vapour is also very irritating. The constitutional effects are analogous to those of iodine. Uses.—It is used in the same cases as iodine, than which it is usually regarded as possessing more activity. Dose.—One or two drops dissolved in water.—Vide *Potassii Bromidum.* Antidotes.—The same as for iodine.

Cajuputi Oleum.—Vide *Melaleuca Minor.*

Calamina.—Vide *Zincum.*

Calumbæ Radix.—Vide *Cocculus Palmatus.*

Calx—*Lime.* Preparation.—Chalk is exposed to a very strong fire during an hour, by which the carbonic acid is expelled. Properties.—Lime, when pure, is a white solid; it has an acrid, alkaline taste, and re-acts powerfully on vegetable colours as an alkali; exposed to the air it attracts water and carbonic acid. If a small portion of water be added to lime, part of it combines with the lime, with a considerable evolution of heat. The lime swells up and falls to powder: in this state it is called *slaked lime*, or the *hydrate of lime.* Lime dissolves in water, forming *lime-water*, or *aqua calcis.* It is remarkable that water at 32° dissolves nearly twice as much lime as water at 212°. Characteristics.—Lime-water is recognized by its action on turmeric paper, and by the precipitate produced by adding carbonic or oxalic acid, or the salts of these acids. Effects.—Quick-lime is an escharotic; Lime-water is a local astringent; internally it is antacid, astringent, diuretic, and alterative. Uses.—As an antilithic in the lithic acid diathesis, as an antacid in dyspepsia, and as an astringent wash to ulcers attended with excessive secretion. Dose.—Lime-water may be given in doses of from f. ℥ fs. to f. ℥ iv. three times a day.

Calcii Chloridum—*Chloride of Calcium.* Preparation.—Add hydrochloric acid to carbonate of lime; when the effervescence has ceased, the filtered solution is evaporated, and the residue fused in a crucible; while in the liquid state it is to be poured on a clean flat stone, and, when cold, broken into small pieces, and preserved in a well-stopped vessel. Properties.—A white translucent solid, having a bitter and acrid saline taste; it has a great attraction for water, and deliquesces in the air. Effects.—Much the same as those produced by chloride of barium. Uses.—Chiefly in scrofula, attended with glandular enlargements. In pharmacy it is used in the rectification of spirit, on account of its strong affinity for water. Dose.—It is given in the form of aqueous solution. The liquor calcii chloridi, consists of four ounces of the chloride dissolved in twelve fluid ounces of distilled water. The dose is ♏ xl., or ♏ l.

Calcis Hypochloris—*Hypochlorite* or *Chloride of Lime.* Preparation.—It is prepared by conveying chlorine gas into a vessel or chamber containing slaked lime. Properties.—Chloride of lime is a brownish white powder, having a feeble odour of chlorine, and a strong bitter and acrid taste; exposed to the air it evolves chlorine and attracts carbonic acid. Its solution in water has bleaching properties. Composition.—Chemists are not agreed as to its exact nature. It is probably a mixture of chloride of calcium and hypochlorite of lime. Effects.—Its local action is that of an irritant and desiccant; when the secretions are excessive and fœtid, it diminishes their quantity and improves their quality. Internally it acts as an alterative, stimulant, and antiseptic. Uses.—Extensively used as a disinfectant and antiseptic; when exposed to the air in sick chambers, it slowly evolves chlorine, and has a remarkable power of destroying unpleasant odours. Its power of destroying infection or contagion is, however, more doubtful; indeed some experiments which have been made seem to prove that it really has no such power.—Vide Pereira's *Mat. Med.* Chloride of lime is very useful when locally applied in checking the putrefactive process, and in correcting the unpleasant odour of putrid discharges. It is also given internally with great benefit in putrid fevers, especially in malignant scarlatina; a strong solution is said to be very successful in the cure of itch. Dose, gr. j. to grs. vj.

Calcis Carbonas—*Carbonate of Lime.*—It exists native in great abundance, as chalk, marble, &c. For medicinal purposes, *prepared chalk* is freed from impurities, and reduced to a finely divided state by the process of eleutriation. Properties.—It is a tasteless, odourless solid, and requires 1600 parts of water to dissolve it. It is more soluble in carbonic acid water; by heating such a solution, the carbonic acid escapes, and the carbonate of lime is deposited. Composition.—1 eq. carbonic acid, 1 eq. lime. Effects.—Chalk is an absorbent, antacid, and astringent. Uses.—As a desiccant in some cutaneous diseases. Internally as an antacid in dyspepsia and an astringent in diarrhœa. It is a convenient antidote in cases of poisoning by the strong acids. Dose, grs. x. to ʒ j. It enters into the composition of a considerable number of officinal preparations.

Cambogia.—Vide *Hebradendron Cambogioides.*

Camphora Officinarum—*The Camphor Tree.—Sex. syst. Enneandria. Monogynia. Nat. ord. Lauraceæ.* Hab.—China, Japan, and Cochin China. Extraction.—The roots and wood of the tree, chopped up, are boiled with water in an iron vessel, to which an earthen head containing straw is adapted. The camphor sublimes and condenses on the straw. The crude camphor thus procured is refined by a second sublimation. Properties.—Refined camphor is met with in large hemispherical cakes. It is translucent, having a peculiar aromatic odour, and an aromatic bitter taste. It evaporates in the air at ordinary temperatures; but in closed vessels, exposed to light, sublimes and crystallizes on the sides of the bottle. Its specific gravity is ·985. It is very slightly soluble in water, but readily soluble in alcohol. Composition.—C_{10}, H_8, O. Effects.—Camphor is stimulant, diaphoretic, and narcotic; its stimulant action is very transitory, and soon followed by sedative effects. It becomes absorbed, acting on the nervous system, and escaping by transudation through the skin and mucous membrane of the lungs. In moderate doses it operates as a cordial, increasing the heat of the body, rendering the pulse fuller, and promoting diapho-

resis; in larger doses it allays irritation, pain, and spasm, and induces sleep. In very large doses it produces vomiting, delirium, convulsions, and other noxious effects. Uses.—As a cordial in typhoid fevers and the latter stages of some inflammatory diseases, also in some forms of mania and melancholia. As a sedative in some spasmodic diseases, and in irritation of the urinary and sexual organs. It is sometimes applied externally as an anodyne or local stimulant. It is a mistake to suppose that camphor bags have any prophylactic power against contagion. Dose—from grs. iij. to grs. x. or more. It is best given in the form of emulsion. *Mistura Camphoræ* is a solution of camphor in water, with a little rectified spirit. *Tinctura Camphoræ* is a solution of camphor in rectified spirit, the dose is ♏ x. to f. ʒ j. *Tinctura Camphoræ Composita*, in addition to camphor, contains opium, benzoic acid, and oil of anise. It is much used to allay cough unattended by inflammatory symptoms. Dose, f. ʒ j. to f. ʒ iij. Antidotes.—Evacuate the stomach, and subsequently give brandy or wine as a stimulant.

Canella Alba—*Canella Bark.* Hab.—West Indies and continent of America. Part used.—The bark. Description.—It occurs in quills, which are hard, of a yellowish white colour, somewhat lighter on the inner surface, and have an aromatic clove-like odour and an acrid peppery taste. Composition.—The most important constituents are *volatile oil*, *resin*, and *bitter extractive matter*. Effects.—Aromatic, stimulant, and tonic. Uses.—Chiefly as an aromatic addition to purgatives and tonics in dyspepsia and debility. Dose, from grs. x. to ʒ ſs.

Cantharis Vesicatoria—*The Blistering Fly.—Cl. Insecta. Ord. Coleoptera.* Hab.—South of Europe. They are found on species of *Oleaceæ* and *Caprifoliaceæ*. The insect is two-thirds of an inch long and one-fourth of an inch broad, of a green, gold-shining colour; with long flexible elytra or wing-sheaths, marked with three longitudinal raised stripes, and covering brown, membranous, transparent wings. The body is terminated by two small sharp spines, and on the head are two black pointed feelers. They are caught during the month of May by spreading large cloths under the trees, which are then strongly shaken or beaten with long poles. They are killed by steams of boiling vinegar, and dried either by the sun or in a stove. Composition.—The active properties of cantharides depend on a principle called *cantharidin*, which is a solid, crystallizing in micacious plates, fusible, vaporizable, soluble in ether and hot alcohol. Effects.—The topical effects of cantharides are those of a powerful irritant. Applied to the skin, the first effects are a sensation of heat, with pain, redness, and swelling. Subsequently serum is effused, and raises the epidermis, forming a *blister*. Internally, in small doses, it produces a sensation of warmth in the stomach, and after a time a tickling sensation in the urethra, with frequent desire to pass the urine, which is often increased in quantity. In larger doses it produces great pain in the loins and bladder, the urine being often bloody and passed with difficulty. In very large quantities the symptoms produced are those of violent inflammation of the intestinal canal, followed by those of excessive irritation of the urinary organs. Occasionally the sexual feelings are excited by the use of cantharides. Abortion has sometimes been the consequence of a large dose. The external application of cantharides is sometimes followed by pain in the bladder, and difficulty in passing the water. Uses.—The chief use of cantharides is for external application to produce rubefaction and vesication in a number of cases which it would be tedious to enumerate: for this purpose the *Emplastrum Cantharidis* is generally employed. When a speedy blister is required, the *Acetum Cantharidis* is very useful. Internally they are sometimes given as a diuretic in dropsy, as a stimulant to the bladder in some cases of incontinence, and it is also an useful remedy in some chronic cutaneous diseases. For internal use the *tincture* is usually given in doses of from ♏ x. to ʒ j.

The powdered cantharides may be given in doses of one or two grains in the form of pill. Antidote.—Remove the poison as soon as possible by the stomach-pump, or by emetics, or by tickling the throat. Assist the vomiting by the copious use of mucilaginous and albuminous demulcent drinks. No chemical antidote is known.

Capsicum Annuum—*Capsicum or Cayenne Pepper.—Sex. syst. Pentandria. Monogynia. Nat. ord. Solanaceæ.* Hab.—America. Cultivated in England. Part used.—The dried fruit. Composition.—Its properties depend on the presence of an acrid volatile liquid, soluble in ether, which is called *capsicin*. Effects.—Applied to the skin, capsicum produces rubefaction and vesication. Internally it is an aromatic stimulant. Uses.—It is much used as a condiment. In medicine it is chiefly used as a local stimulant to the mouth, throat, and stomach. As a general stimulant it is of little value, its constitutional not being in any degree proportioned to its topical effects. It forms a valuable gargle in relaxed sore throat, and an useful stimulant in atonic dyspepsia. Dose.—The *powder* may be given in doses of from gr. v. to gr. x. The dose of the *tincture* is from ♏ x. to f. ℈ j.

Carbo-Animalis—*Animal Charcoal*—prepared by burning bones, and removing the carbonate and phosphate of lime by maceration in dilute hydrochloric acid. We thus obtain charcoal in a very finely divided state.

Carbo Ligni—*Wood Charcoal.*—For medicinal purposes it is procured by heating wood in iron cylinders, the gaseous products being allowed to escape. Properties.—Charcoal has the property of removing certain organic colouring matters, and various odorous matters from liquids in which they are dissolved. Another property is that of condensing within its pores a certain volume of any gas with which it may be brought in contact. The decolorizing power is possessed in a more eminent degree by animal charcoal; this is supposed to arise from the minute separation of the carbonaceous particles effected by the presence of other matters, as of phosphate of lime when bones are employed. Effects.—Charcoal appears to produce no evident effect on a healthy individual. Uses.—It is sometimes added to poultices to absorb the fœtid odour of sloughing ulcers; and internally it has been employed in dysentery to correct the fœtor of the evacuations. As a tooth-powder it is a valuable agent. It is said to have been given with success in intermittent fever. The chief use of the animal charcoal is for the decolorization of the vegetable alkaloids, as morphia, quinia, &c. Dose, grs. x. to a table-spoonful or more.

Cardamomum.—Vide *Elettaria Cardamomum.*

Carum Carui—*The Caraway.—Sex. syst. Pentandria. Digynia. Nat. ord. Umbelliferæ.* Hab.—All over Europe. Naturalized in England. Parts used.—

The mericarps, commonly called the seeds. Composition.—Its aromatic qualities depend on a volatile oil. Effects and Uses.—An aromatic stimulant and carminative. It is useful in relieving flatulent colic, and is added as a corrective to several other medicines. Dose.—It is usually given in the form of the oil, spirit, or water. The dose of the oil is ♏ j. to ♏ x.

Caryophyllus Aromaticus—*The Clove Tree.*—*Sex. syst. Icosandria. Monogynia. Nat. ord. Myrtaceæ.*—Hab.—East India Islands. Parts used.—The clove is the unexpanded flower, the corolla forming a ball at the top between the four teeth of the calyx. Composition.—*Volatile oil*, *resin*, and *tannin* are the most important constituents of cloves. Effects and Uses.—The same as those of the caraway. An infusion of cloves forms an agreeable aromatic stomachic, in doses of from f. ℥ i. to ℥ ij.

Cascarilla.—Vide *Croton Eleuteria*.

Cassia Fistula—*The Purging Cassia.*—*Sex. syst. Decandria. Monogynia. Nat. ord. Leguminosæ.*—The *pulp* is obtained by pouring boiling water upon the bruised pods, pressing, filtering, and evaporating the water until the pulp acquires a proper consistence. Composition.—The chief constituent of the cassia pulp is sugar. Effects and Uses.—In small doses it is laxative, in larger ones purgative, occasioning nausea, flatulence, and griping. Dose, from ʒ j. to ℥ j.

Cassia Lanceolata, C. Obovata, C. Acutifolia, C. Elongata—*Senna.*—These species of cassia, which yield the senna of commerce, are natives of Upper Egypt, Central Africa, and India. Senna leaflets vary in shape as yielded by the various species; but they all resemble each other in being unequal at the base. This will serve to distinguish senna leaflets from the various leaves with which they are commonly adulterated. The most serious adulteration consists in the substitution of the leaves of *Coriaria Myrtifolia* for those of senna. These leaves are ovate-lanceolate, three-nerved, with a strongly marked mid-rib. Chemically, they are distinguished by their infusion yielding with gelatine a whitish precipitate (*tannate of gelatine*), and with sulphate of iron a very abundant blue precipitate (*tannate of iron*). Another adulteration consists in adding the leaves of *Cynanchum Argel* to those of the senna. Argel leaves are distinguished by being equal sided, by the absence of lateral nerves, by their pale colour and coriaceous texture, and by their greater length. The greater part of the senna of commerce is imported from Alexandria. The Tinnevelly Senna consists of the leaflets of Cassia Elongata, and is considered very fine, and free from adulteration. Composition.—Senna contains a peculiar principle called *cathartin*, soluble in water and alcohol. This is the purgative principle of senna. Effects.—Senna is a certain and safe purgative. Its ill effects are nausea, griping, and flatulence. It is one of the mildest of the drastic purgatives. If infusion of senna be given to the nurse, the sucking infant becomes purged. Uses.—Senna is adapted for those cases which require an active and certain purgative, with a moderate stimulus to the intestines; for example, in habitual constipation, in worms, and in determination of blood to the head. Dose.—Powdered senna may be given in doses of from ʒ fs. to ʒ ij. *Infusum Sennæ Compositum* is made with senna, ginger, and boiling water; the dose is from f. ℥ ij. to f. ℥ iv. *Tinctura Sennæ Composita*, contains senna, caraway, cardamom, raisins, and proof spirit. The dose is from f. ʒ ij. to f. ℥ j. The *syrup* and the *confection* of senna are sometimes used.

Castor Fiber—*The Beaver.*—*Cl. Mammalia. Ord. Rodentia.* Hab.—North America and the North of Europe. Source of Castor.—Between the anus and the external genitals are four follicles; the two smaller are filled with a fatty substance, while the two larger contain each about two ounces of an oily, strong-smelling substance, which is the officinal castor. The follicles are cut off entire and dried. The best comes from Russia; but the greater part of that found in the shops is the produce of Canada. Composition.—The most important constituents are *volatile oil*, *castorine*, and *resin*. Effects and Uses.—Castor is denominated a stimulant and antispasmodic. Formerly it was much used in spasmodic diseases, as hysteria and epilepsy. It is now considered almost inert, and is seldom employed. Dose, ℈ ij.

Centaurium. Vide *Erythræa Centaurium*.

Cephaelis Ipecacuanha—*The Ipecacuanha.*—*Sex. syst. Pentandria. Monogynia. Nat. ord. Rubiaceæ.*—Hab. -- South America. Part used. — The root. Composition.—Ipecacuanha contains about 15 per cent. of a principle called *emetin*, very minute doses of which produce vomiting. Effects.—The powder of ipecacuanha, when inhaled, sometimes produces great difficulty of breathing, and symptoms similar to an attack of asthma. Internally, in small doses, it increases the secretion of the bronchial mucous membrane, and acts as an expectorant. In somewhat larger doses it produces nausea, and if the skin be kept warm, diaphoresis. In full doses it excites vomiting, followed by drowsiness. It is a very safe emetic, since an overdose will not give rise to inflammation. Uses.—As an *emetic* it is given in some cases of poisoning, in gastric disorders, as a counter-irritant at the commencement of fevers, and in many inflammatory disorders. As a *nauseant*, *diaphoretic*, and *expectorant*, it is given in affections of the respiratory organs. Thus an attack of croup may frequently be cut short by continued nauseating doses of ipecacuanha. It has also gained great celebrity for its influence over dysentery. In various other maladies, ipecacuanha is given as a sudorific, combined with opium. Dose.—As an emetic, about grs. xv. is usually given. As a nauseant, from gr. j. to gr. iij. As an expectorant and sudorific, the dose is gr. j. Vinum Ipecacuanhæ—(Ipecacuanha, bruised, ℥ ij. fs., Sherry wine, O ij. Macerate for fourteen days, and strain). Dose.—As a diaphoretic and expectorant, ♏ x. to ♏ xl.; as an emetic, f. ʒ ij. to f. ʒ iv. For children, the dose as an emetic is from ♏ xx. to f. ʒ j.; according to the age of the child. Pulvis Ipecacuanhæ Compositus—*Dover's Powder*—(Ipecacuanha, powdered; hard opium, powdered, of each ʒ j.; sulphate of potash, powdered, ℥ j., mix them). This is one of our most certain, powerful, and valuable sudorifics in doses of from grs. v. to grs. x.

Cerevisiæ Fermentum—*Yeast.*—This is the scum or frothy matter which collects on the surface of beer while fermenting. It is chiefly composed of gluten in a certain state of decomposition. It also contains some alcohol and carbonic acid. Effects and Uses.—Yeast is considered to be tonic and antiseptic. Its chief use is as an external application to foul and sloughing ulcers. It corrects the fœtor of the discharge, and promotes the formation of healthy pus. The *Cataplasma Fermenti* is a mixture of flour and yeast. Its

efficacy is supposed to depend on the evolution of carbonic acid gas during the fermentation occasioned by the presence of the yeast.

CERVUS ELAPHUS—*The Stag.—Cl. Mammalia. Ord. Ruminantia.* HAB.—Europe, Asia, and North of Africa. PART USED.—The shavings or raspings of the horns. COMPOSITION.—*Gelatine*, *carbonate* and *phosphate of lime*. EFFECTS AND USES.—Decoction of hartshorn is nutrient, emollient, and demulcent. Hartshorn shavings are directed to be used in the manufacture of *Antimonial Powder*. *Cornu Ustum.*—Burn pieces of horn in an open vessel until they become perfectly white; then powder and prepare them by *eleutriation*. In this process the animal matter is burnt away, leaving the earthy salts. USES.—Burnt hartshorn has been given in rickets with the view of promoting the deposition of bone-earth in the bones.

CETACEUM.—Vide *Physeter Macrocephalus*.

CETRARIA ISLANDICA.—Vide *Lichen*.

CHIMAPHILA UMBELLATA.—*The Winter Green.—Sex. Syst. Decandria. Monogynia. Nat. ord. Pyrolaceæ.* HAB. — Europe, Asia, and North America. PARTS USED.—The leaves and stems. COMPOSITION.—It contains *bitter extractive*, *resin*, and *tannin*. The active principle has not been isolated. EFFECTS.—An infusion of the dried leaves acts as a tonic and diuretic. Its action is analogous to that of the uva ursi. USES.—It is used as a diuretic in dropsies attended with debility. It has been found useful in chronic inflammation and catarrh of the bladder, and in scrofula. *Decoctum Chimaphilæ.*—Chimaphila ℥ j. water O i. ſs., boil down to a pint and strain. Dose, f. ℥ j. to f. ℥ ij.

CINCHONA.—*Several species yielding Peruvian Bark.—Sex. syst. Pentandria. Monogynia. Nat. ord. Rubiaceæ.*—Dr. Lindley mentions twenty-six species of cinchona, of which twenty-one are well known. The London Pharmacopœia, on the authority of Mutis, assumes that the three kinds of bark found in the shops are furnished by three distinct species, namely, *C. lancifolia*, *C. cordifolia*, and *C. oblongifolia*. There is much reason to doubt the accuracy of this arrangement. HAB.—The cinchona species inhabit the Andes, from 11° N. lat. to 20° S. lat., at varying elevations. BARK-PEELING. — The mode of obtaining the bark varies in different districts. In some parts the trees are cut down before the peeling is performed; but in other districts the bark is removed while the trees are standing. Cinchona is imported from various parts of the Pacific coast of South America. There are three kinds of genuine cinchona barks in English commerce,—the *pale*, the *yellow*, and the *red*. *Pale barks* have the following properties: They always occur in quills, never in flat pieces; their powder is more or less pale, greyish, or fawn-coloured, and their taste is astringent and bitter. They contain *cinchonia* and *quinia*. *Yellow bark* occurs in quills or flat pieces, the quills being generally larger and rougher than the quills of pale barks; the texture is more fibrous, and the taste more bitter and less astringent than that of pale bark; the powder is orange or fawn-yellow. It contains both quinia and cinchonia, but the first in by far the larger quantity. *Red bark* is met with in both quills and flat pieces; it has a fibrous texture and a redder colour than either of the preceding varieties; it contains both quinia and cinchonia; it is very bitter and astringent; its powder is more or less red. COMPOSITION. — The various kinds of cinchona bark contain variable proportions of the two alkalies, cinchonia and quinia, in combination with kinic acid. A third alkali was discovered in *arica cinchona*, by Pelletier and Cariol, in 1829; to this they gave the name of *Aricina*. These barks also contain tannin, colouring matter, various salts, &c. According to Goebel,* one pound of the best pale bark contains 168 grs. of cinchonia. The same quantity of the best yellow barks contains from 60 grs. to 95 grs. of quinia, and an equal amount of the true red barks contains from 20 grs. to 65 grs. of cinchonia, and from 16 grs. to 40 grs. of quinia. Cinchonia, quinia, and aricina may be considered as oxides of a common base (composed of $C_{20}\,H_{12}\,N$), which has been termed quinogen. According to this hypothetical view, cinchonia is a *monoxide*, quinia a *binoxide*, and aricina a *teroxide* of quinogen. The chemical tests for the goodness of cinchona barks are those which detect the tannic acid, and those which detect the vegetable alkalies. EFFECTS OF THE CINCHONA BARKS.—The topical effects are astringent and slightly irritant; the constitutional effects in some conditions of the system are those of an irritant or stimulant, in others those of a stomachic, tonic, and corroborant. The irritant and stimulant effects of cinchona are best seen when a full dose is given to a healthy person, or a moderate dose to a person labouring under gastro-enteritic irritation accompanied with fever. In such cases it produces disorder of the alimentary canal, with thirst, vomiting, headache, and great febrile disturbance. The tonic effects are evident in persons suffering from debility without local irritation. In such cinchona improves the appetite, promotes the digestive functions, and increases the strength. Cinchona, in addition to its general tonic properties, has the power of arresting the progress of periodic diseases. The efficacy of cinchona barks doubtless depends on the presence of the alkaloids. EFFECTS OF THE CINCHONA ALKALOIDS.—The effects of the alkalies do not differ from those of the bark, except in being more energetic. In large doses, the sulphate of quinia produces irritation of the stomach and intestines, excitement of the vascular system, and disorder of the functions of the brain and spinal chord. There appears no difference in the operation of quinia and cinchonia. It has been asserted that the cinchona alkalies possess all the medicinal properties of the barks, and may be substituted for them on every occasion. This, however, is incorrect, as in some cases the astringent and aromatic properties of the barks give them an advantage over the simple alkalies. In some cases, however, the alkalies are of great advantage, since they enable us to obtain, in a small volume, the tonic operation of a large quantity of bark. USES.—Cinchona is a most valuable tonic in all cases in which the use of tonics is indicated. But the great value of cinchona consists in the power which it possesses in arresting periodic or intermittent diseases. It is the best remedy for intermittent fever. In this disease we may give very large doses of the remedy a few hours before the expected paroxysm, or we may gradually extinguish the disease by the exhibition of moderate doses at short intervals during the whole period of the intermission. Cinchona is also useful in other intermittent diseases, as neuralgia, rheumatism, headache, &c. Cinchona is a valuable remedy in the latter stages of continued fevers, and of inflammatory diseases, and in maladies

* Vide Dr. Pereira's *Materia Medica*.

characterized by atony and debility. Mode of administration.—The powdered bark may be given in doses of from ℈ j. to ʒ j. or more; but it is apt to occasion nausea. The infusion or decoction may be given in doses of f. ℥ j. or f ℥ ij. three times a day. There is a *simple* and a *compound tincture*, the dose of which is from f. ʒ j. to ʒ iij. The dose of the extract is from gr. v. to gr. xx. Quiniæ Disulphas.—The process for obtaining this salt is somewhat complicated. The following is an outline of the process:—By boiling yellow bark in water we obtain a solution of *kinate of quinia;* when ammonia is added to this, the quinia is precipitated, and kinate of ammonia remains in solution. The quinia is then saturated with sulphuric acid; we thus obtain disulphate of quinia, the composition of which is one equivalent of sulphuric acid and two equivalents of quinia. Disulphate of quinia may be given in doses of from gr. j. to gr. v.; larger doses are sometimes given as a febrifuge, but they are apt to disorder the stomach. It may be given in the form of a pill, or in solution with an acid, as in the compound infusion of roses.

Cinnamomum Zeylanicum—*The Cinnamon.—Sex. syst. Enneandria. Monogynia. Nat. ord. Lauraceæ.* Hab.—Ceylon and Java. Part used.—The bark of the small branches. Composition.—*Volatile oil, tannin, mucilage,* and *resin* are the most important constituents. Effects and Uses.—Cinnamon produces the usual effects of an aromatic stimulant and tonic; it is also slightly astringent. It is much used as a condiment, and in medicine combined with other tonics and astringents. Dose.—The powder may be given in doses of from grs. x. to ʒ fs. In the Pharmacopœia we have *Aqua Cinnamomi,* the *Tinctura Cinnamomi, Tinctura Cinnamomi Composita, Oleum Cinnamomi,* and *Spiritus Cinnamomi.*

Cissampelos Pareira—*The Pareira Brava, or Velvet Leaf.—Sex. syst. Diœcia. Monadelphia. Nat. ord. Menispermaceæ.* Hab.—West Indies. Part Used.—The root, which occurs in more or less cylindrical pieces, some of which are as thick as a child's arm; externally they are covered by a dark brown rind. Composition.—The most important constituents are *fecula, supermalate of lime, nitrate of potash,* and some *ammoniacal* and *mineral salts.* It is also said to contain a vegetable alkali, called *Cissampelin.* Effects.—Pareira acts as a diuretic and tonic, and appears to exert some specific influence over the mucous membrane of the urinary organs. Uses.—It is chiefly used in discharges from the urino-genital mucous membrane, as gonorrhœa, leucorrhœa, and chronic inflammation of the bladder. It may be given in the form of *infusion* or *extract.*

Citrus Limonum—*The Lemon Tree.—Sex. syst. Polyadelphia. Polyandria. Nat. ord. Aurantiaceæ.* Hab.—A native of Asia, cultivated in the south of Europe. Parts used.—The rind and the juice. Composition.—The *peel* contains *volatile oil* and a *bitter extractive principle.* The *juice* contains *citric* and *malic acid.* Effects and Uses.—Lemon-*peel* is an aromatic stomachic and tonic, and as such is often added to other tonics, as in the compound infusion of gentian. Lemon-*juice* furnishes an agreeable and refreshing beverage, and is refrigerant and antiscorbutic. It is used in the preparation of refrigerant drinks, in the formation of the effervescing draught, as an antiscorbutic, as an antidote in cases of poisoning by the alkalies or their carbonates, and for the preparation of citric acid.—Vide *Acidum Citricum.*

Citrus Vulgaris—*The Bitter Orange-tree.—Sex. syst. Polyadelphia. Polyandria. Nat. ord. Aurantiaceæ.* Hab.—Asia; cultivated in Europe.—Parts used.—The rind and the juice. Composition.—The composition of orange peel and juice is analogous to that of the same parts of the lemon. The juice of the orange contains sugar, and has less acid than that of the lemon. Effects and Uses.—Much the same as those of the lemon; the orange-juice containing less acid is not adapted for forming the effervescing draught.

Cocculus Palmatus—*The Calumba Plant.—Sex. syst. Diœcia. Hexandria. Nat. ord. Menispermaceæ.* Hab.—Shores of Oïbo and Mozambique. Parts used.—The roots. It is met with in circular or oval pieces of from half an inch to three inches diameter, and from one to three or four lines thick; it occurs also in cylindrical pieces of from one to two inches long. The epidermis is of a yellowish-grey or brownish colour. Composition.—It contains a *volatile odorous principle,* a *bitter principle* (*Calumbin*), *gum,* and about one-third by weight of *starch.* Effects and Uses.—Calumba is a mucilaginous tonic, without being a stimulant. It may be given as a tonic in the early stage of convalescence from febrile and inflammatory diseases, before other tonics, which are also stimulants, are admissible. It is also useful in dyspepsia, and to allay vomiting when not dependent on inflammation of the stomach. Dose.—The powder may be given in doses of from grs. x. to ʒ fs.; the *infusion* from f. ℥ j. to f. ℥ ij.; the *tincture* from f. ʒ j. to f. ʒ ij.

Coccus Cacti—*The Cochineal Insect.—Cl. Insecta. Ord. Hemiptera.* Hab.—Mexico. The insects feed on the *nopal plant.* They are domesticated and reared with the greatest care. They are collected by brushing them off with a squirrel's tail. They are killed by immersion in hot water, and are subsequently dried in the sun or by the heat of a stove. Cochineal consists of the dried female insects, which are about one or two lines long, and of an irregular figure. They are inodorous, have a bitterish taste, tinge the saliva violet-red, and yield a dark red powder. Composition.—A brilliant purplish-red substance called *cochinellin,* or *carmine, peculiar animal matter, fatty matter,* and *salts.* Uses.—The only use of cochineal is as a colouring matter. In the arts it is much used for dying scarlet and crimson, and in the manufacture of *carmine* and *lake.*

Cochlearia Armoracia—*The Horse-Radish.—Sex. syst. Tetradynamia. Siliculosa. Nat. ord. Cruciferæ.* Hab.—Indigenous. Parts Used.—The root. Composition.—The properties of horse-radish depend on the presence of an *acrid volatile oil.* Effects.—Horse-radish is a pungent acrid stimulant; applied to the skin it produces vesication; taken internally it promotes the secretion of urine and of perspiration; in large doses it is emetic. Uses.—Chewed, it forms a good masticatory; an infusion may be used to excite vomiting in cases of narcotic poisoning. As a stimulant, diaphoretic, and diuretic, it has been used in palsy, chronic rheumatism, and dropsy. Dose.—ʒ fs. or more.

Colchicum Autumnale—*The Meadow-Saffron.—Sex. syst. Hexandria. Trigynia. Nat. ord. Melanthaceæ.* Hab.—Indigenous. Parts used.—The *cormus* and the *seeds.* The *cormus* should be gathered about the months of July and August, that is, between

the withering of the leaves and the sprouting forth of the flower. At this period the new cormus is fully developed, and has not exhausted itself by the production of the flower. The *seeds* should be gathered when fully ripe. Description.—The *cormus* is about the size of a chestnut, and somewhat resembles in external appearance the cormus of the common tulip. It is rounded on one side, flattened on the other, where is perceived the fibrous germ of a new cormus, which, if allowed to grow, shoots up and bears the flower, while the old cormus wastes, becomes insipid, and inert. It is covered by two coats, an inner reddish-yellow, and an external brown one. Internally the cormus is white, fleshy, and has an acrid bitter taste. Before drying the cormus, it should be cut transversely in thin slices, the dry coats being previously removed. The seeds are about the size of those of white mustard, without odour, and having a bitter acrid taste. Composition.—Colchicum cormus, in addition to the ordinary constituents of vegetable substances, contains *veratria*, and, according to Geiger and Hesse, a peculiar principle called *colchicina*, which is a powerful poison. Effects.—In small doses colchicum (the seeds or cormus) promotes the action of the secreting organs, especially of the intestines: in some cases the secretions of the skin and kidneys are considerably increased: it probably increases the biliary secretion. In larger doses it produces nausea, vomiting and purging, reduction of the frequency and force of the pulse, and, in some cases, faintness and extreme depression. Under some circumstances colchicum acts as an anodyne. In excessive doses it is a powerful irritant poison. Uses.—Colchicum is chiefly celebrated for its efficacy in alleviating the gouty paroxysm; it relieves the pain and cuts short the attack. Its *modus medendi* is not satisfactorily ascertained: some consider it a specific, while others assert that it acts by the purging and the depression of the heart's action which it induces. In *rheumatism* colchicum is much less efficacious. Dose.—The powder of the cormus and the seeds may be given in doses of from grs. ij. to grs. viij. There are various preparations in the Pharmacopœia: *Tinctura (Seminum) Colchici*, dose from f. ʒ ſs. to f. ʒ j. *Vinum (Cormi) Colchici*, dose ♏x. to f. ʒ ſs.; *Acetum (Cormi) Colchici*, dose ♏x. to f. ʒ j.; *Extractum (Cormi) Colchici Aceticum*, dose gr. i. to gr. iij.; *Extractum Colchici Cormi*, dose, gr. i. Antidotes.—Promote vomiting by the use of tepid demulcent drinks, and counteract the depressing effects by the exhibition of stimulants.

Colocynthis.—Vide *Cucumis Colocynthis.*

Conium Maculatum—*The Spotted Hemlock.—Sex. syst. Pentandria. Digynia. Nat. ord. Umbelliferæ.* Hab.—Indigenous. Parts used.—The *leaves.* The conium maculatum may be distinguished from the other umbelliferæ by attention to the following characters:—The large, round, smooth, spotted *stem;* the smooth, dark, and shining green colour of the lower *leaves;* the *general involucre* of from three to seven leaflets; the *partial involucre* of three leaflets; the fruit with undulated crenated ridges. The whole herb, when bruised, has a disagreeable odour, compared by some to that of mice, by others to that of fresh cantharides, or of cats' urine. Composition.—The most important constituents are a *volatile odorous matter* and *conia.* Conia exists in hemlock in combination with an acid. It is an oily looking transparent liquid, having the odour of hemlock, and an acrid taste; it is sparingly soluble in water, but entirely soluble in alcohol and ether; it combines with acids and forms salts. Effects.—In small doses hemlock is considered to have an alterative effect, and has been supposed to have the power of arresting the growth of tumors. In large doses it acts as a narcotic poison; in some cases the leading symptom has been coma, in others convulsions, and in others delirium. *Conia* is a most virulent poison. Dr. Christison has recorded some experiments made on animals. One drop placed in the eye of a rabbit killed it in nine minutes. It acts locally as an irritant, but this effect is soon overwhelmed by the remote action which follows. This consists in a swiftly-spreading palsy of the muscles, affecting first those of voluntary motion, then the respiratory muscles of the chest and abdomen, lastly the diaphragm, and thus ending in death by asphyxia. Uses.—The hemlock has been used with considerable benefit in cases of cancer, scrofula, and chronic skin diseases. In most of these cases it relieves pain, although it may not have the effect of removing the disease entirely. Dose.—The powder may be given in doses of three or four grains: *Tinctura Conii*, dose f. ʒ ſs. to f. ʒ j.; *Extractum Conii*, dose, grs. ij. or grs. iij. A poultice of hemlock is sometimes applied to painful sores. Antidotes.—Evacuate the stomach as soon as possible; the subsequent treatment must depend on the symptoms. Artificial respiration should not be omitted in extreme cases.

Convolvulus Scammonia.—*The Scammony.—Sex. syst. Pentandria. Monogynia. Nat. ord. Convolvulaceæ.* Hab.—Greece and the Levant. Part used.—The gum-resin. Preparation.—The earth is cleared from the upper part of the root, the top is cut off obliquely, the milky juice exudes, and is collected in a shell; it soon becomes hard, and is the genuine scammony. Adulteration.—It sometimes contains chalk and starch; the first is detected by adding an acid, the second by iodine. Composition.—Scammony contains about 80 per cent. of *resin*, with some gum, extractive, &c. Effects and Uses.—Scammony is a powerful drastic purgative, being more violent in its action than jalap, but less so than gamboge. It is well adapted for torpid conditions of the intestines. It is an useful and safe purgative for children in cases of worms, &c. Dose.—For an adult from grs. v. to grs. xv.

Contrajerva Radix.—Vide *Dorstenia Contrajerva.*

Copaifera—*Several species yielding Copaiba.—Sex. syst. Decandria. Monogynia. Nat. ord. Leguminosæ.* Hab.—South America and West Indies. Part used.—The balsam, which is obtained by making incisions into the stems of the trees. Composition.—*Volatile oil* and *resin.* Effects and Uses.—Copaiba is stimulant, diuretic, and gently purgative; it acts on the mucous membrane of the lungs as an expectorant; it also passes off by the skin, as is shown by the eruption which occasionally follows its internal exhibition. In large doses it produces vomiting. It is chiefly used in gleet and gonorrhœa, also in leucorrhœa, chronic inflammation of the bladder, and in chronic pulmonary catarrh. Dose.—♏x. to f. ʒ j.

Coriandrum Sativum.—*The Coriander.—Sex. syst. Pentandria. Digynia. Nat. ord. Umbelliferæ.* Hab.—Indigenous. Part used.—The fruit, which is globular, and about the size of white pepper. Composition.—It contains much volatile oil. Effects and Uses.—Aromatic, stimulant, and carminative. It is used only as an adjuvant or corrigent.

Cornu.—Vide *Cervus Elaphus*.

Creasoton—*Creasote*—prepared from the oil of wood tar. Properties. — Creasote is a colourless transparent liquid, having an oleaginous consistence; Its sp. gr. is 1·037. It is combustible, being a compound of carbon, hydrogen, and oxygen. Effects.—Its local effects are those of an irritant and caustic. Internally it is stimulant, and in large doses produces nausea, vertigo, and headache; it sometimes acts as a diuretic. Uses.—It is much used for the relief of sympathetic vomiting, unaccompanied by gastric inflammation. It has been used in diabetes. In the form of ointment it is a useful remedy in some cutaneous diseases. It is sometimes dropped into a carious tooth for the relief of toothache. Dose.—One or two drops in mucilage.

Creta.—Vide *Calx*.

Crocus Sativus—*The Saffron Crocus.—Sex. syst. Triandria. Monogynia. Nat. ord. Iridaceæ.* Hab.—A native of Asia Minor, naturalized in Europe. Parts used.—The *styles and stigmata*. Composition.—Its most abundant and important constituent is a colouring principle called *polychroite*. Effects and Uses.—Saffron was formerly considered as a cordial, narcotic, and emmenagogue; but modern experience has proved that it possesses no such properties. It is used chiefly as a flavouring and colouring ingredient.

Croton Eleuteria—*The Cascarilla.— Sex. syst. Monœcia. Monadelphia. Nat. ord. Euphorbiaceæ.* Hab.—The Bahama Islands, Jamaica. Part used.—The bark. It exists in the form of quills, from one to four inches long, the fragments being thin and curved both longitudinally and transversely, the quills vary in size from that of a writing pen to that of the little finger. The taste is warm and bitter, the odour peculiar but agreeable. Composition.—Its aromatic and medicinal properties depend on the presence of *volatile oil, resin*, and *extractive*. Effects and Uses.—Cascarilla is an aromatic bitter tonic, and as such is useful in many forms of dyspepsia, and in other cases where tonics are indicated. The *infusion* is given in doses of f. ℥ j. or f. ℥ ij., the *tincture* of f. ʒ j. or f. ʒ ij.

Croton Tiglium—*The Purging Croton.—Sex. syst. Monœcia. Monadelphia. Nat. ord. Euphorbiaceæ.* Hab.—India, Indian Archipelago, and Ceylon. Part used.—The oil expressed from the seeds. The oil is of a yellowish-brown colour, and has an unpleasant odour and an acrid taste. It reddens litmus, and is soluble in alchohol. Effects.—Rubbed on the skin the oil produces rubefaction, and a pustular or vesicular eruption. Taken internally it acts as a drastic purgative, giving rise to watery stools, and frequently increasing the urinary secretion. Its operation is very speedy. In large doses it acts as an irritant poison. Uses.—The speedy action of croton oil, and the smallness of the dose, render it a most valuable cathartic in cases of coma, trismus, and obstinate constipation. It is sometimes applied to the skin as a counter-irritant. Dose.—From ♏j. to ♏iij.

Cubeba.—Vide *Piper Cubeba*.

Cucumis Colocynthis—*The Bitter Cucumber, or Colocynth.—Sex. syst. Monœcia. Syngenesia. Nat. ord. Cucurbitaceæ.* Hab.—Japan, India, the Cape, &c., cultivated in Spain. Part used.—The pulp of the fruit. Composition.—The active principle of colocynth is very bitter, and has received the name of *colocynthin*. Effects.—In moderate doses colocynth is a safe and useful purgative; it acts by accelerating the vermicular movements of the intestines, as well as by increasing the secretions. It has an especial action on the *large* intestines. In full doses it acts as a drastic hydragogue cathartic; in excessive doses it is an irritant poison. Uses.—It is used in habitual and obstinate constipation, in diseases of the brain, in dropsy, &c. Dose.—The powder may be given in doses of from grs. ij. to grs. x.; the most common mode of administering it is in the form of the *compound extract*, in which the colocynth is combined with aloes, scammony, cardamoms, and soap. The dose of this is from gr. v. to ℈ j.

Cupri Sulphas—*Sulphate of Copper*. Preparation.—It may be obtained by evaporating the water found in copper mines; it is also produced by roasting the native sulphuret of copper, lixiviating the residuum to dissolve the sulphate, and evaporating so as to obtain crystals. Properties.—This salt is in blue crystals; it has a styptic metallic taste, and re-acts on litmus as an acid. Characteristics.—That this salt is a sulphate may be known by the precipitate afforded with chloride of barium, which is insoluble in acids or alkalies; that the base is copper may be ascertained by plunging a polished iron plate into the solution, when it becomes coated with metallic copper. Composition.—One eq. oxide of copper, one eq. sulphuric acid, and five eqs. water. Effects.—In small doses sulphate of copper is astringent; in larger doses it acts speedily as an emetic, without producing disorder of the general system; in excessive doses it is an irritant poison. Uses.—As an astringent in diarrhœa, as a tonic in some nervous diseases, and as an emetic in cases of narcotic poisoning; it is also used *locally* as an astringent. Dose.—As an emetic, from grs. iij. to grs. xv.; as an astringent, from gr. $\frac{1}{4}$ to grs. ij. Antidotes.—Albumen or iron filings.

Cupri Ammonio-Sulphas — *Ammonio-sulphate of Copper*. Preparation.—An ounce of sulphate of copper is rubbed with an ounce and a half of sesquicarbonate of ammonia until carbonic acid ceases to escape. Composition.—It is composed of carbonate of copper and sulphate of ammonia, with the excess of sesqui-carbonate of ammonia employed. Effects and Uses.—Similar to those of the sulphate of copper, than which it is somewhat more stimulant. Dose, from gr. ſs. to gr. v.

Cupri Diacetas—*Diacetate of Copper—Verdigris*—prepared by exposing plates of copper to acetic acid. The acetate which forms is scraped off and collected. Properties.—It occurs in masses or in powder. It is of a bluish-green colour, having an astringent metallic taste, and an odour something like that of acetic acid. Characteristics.—When digested with strong sulphuric acid, it evolves acetic acid, which is distinguished by its odour. Composition.—Two eqs. oxide of copper, one eq. acetic acid, six eqs. water. Effects and Uses.—Its effects are much the same as those of the sulphate, but on account of the uncertainty of its action it is never given internally. Antidotes.—The same as for the sulphate.

Cusparia.—Vide *Galipea Cusparia*.

Cytisus Scoparius—*Common Broom.—Sex. syst. Diadelphia. Decandria. Nat. ord. Leguminosæ.* Hab.—Indigenous. Parts used.—The tops. Composition.—Broom tops contain *volatile oil, tannin*, &c. Effects and Uses.—In small doses they are diuretic, and, in

large doses, emetic and purgative. They are used in dropsies, usually in the form of *infusion* or *decoction*.

Daphne Mezereum—*The Common Mezereon.—Sex. syst. Octandria. Monogynia. Nat. ord. Thymelaceæ.* Hab.—Indigenous. Part used.—The bark of the root. Composition.—The active principle of mezereon is an *acrid resin.* Effects.—The local effect is that of an acrid stimulant. Taken internally it is a stimulating diaphoretic, and in some cases a diuretic. Uses.—It is seldom given alone; but generally combined with sarsaparilla in syphilitic and rheumatic affections. It is sometimes used as a masticatory.

Datura Stramonium—*The Thorn Apple.—Sex. syst. Pentandria. Monogynia. Nat. ord. Solanaceæ.* Hab.—Indigenous. Parts used.—The leaves and seeds. Composition.—The medicinal properties of stramonium depend on the presence of an alkali called *daturia.* Effects and Uses.—Its effects closely resemble those produced by belladonna. (Vide Atropa Belladonna). It differs from belladonna in being somewhat more acrid. It is used in nearly the same cases as those in which belladonna is indicated. In some cases of spasmodic asthma, smoking the leaves gives temporary relief. Dose.—The dose of the powdered leaves is gr. j.; of the seeds, gr. ſs.; of the *extract*, gr. $\frac{1}{4}$. gradually increased. Antidotes.—The same as for belladonna.

Delphinium Staphisagria—*Stavesacre.—Sex. syst. Polyandria. Trigynia. Nat. ord. Ranunculaceæ.* Hab.—South of Europe, Levant, and the Canaries. Parts used.—The seeds, which are irregularly triangular, blackish-brown, and wrinkled. Composition.—The seeds contain an alkali called *delphinia*, and a vegetable acid. Effects.—The seeds are emetic and cathartic, but their operation is so violent that they are never used internally. Uses.—They are chiefly employed in powder, mixed with hair-powder, for destroying pediculi of the head.

Digitalis Purpurea—*The Purple Fox-Glove.—Sex. syst. Didynamia. Angiospermia. Nat. ord. Scrophulariaceæ.* Hab.—Indigenous. Parts used.—The leaves and seeds. The leaves should be gathered just before, or during the period of inflorescence. They should be dried in baskets in a drying stove. Composition.—The analyses of digitalis are unsatisfactory; but its active properties are thought to depend on a crystaliine substance, called *Digitalina.* Effects.—In repeated small doses, fox-glove produces disorder of the stomach, nausea, or vomiting. It affects the pulse; in some cases increasing its frequency, more commonly diminishing it, and frequently rendering it irregular and intermittent. It acts on the kidneys as a diuretic, and in some rare cases prôduces salivation. In larger doses it produces vomiting, slow and irregular pulse, coldness of the extremities, syncope, or a tendency to it, giddiness, and confusion of vision. In excessive doses these symptoms are more severe, and often terminate fatally. An important fact is, that during the continued use of small doses a *cumulative* effect is sometimes observed; and dangerous symptoms may suddenly appear, in some cases terminating in death. Uses.—Digitalis is used as a diuretic in dropsy; as a sedative in some cases of fever and inflammation, in hæmorrhages, in diseases of the heart and great vessels, and in phthisis. Dose.—The dose of the *powder* is from gr. ſs. to gr. iſs; of the *infusion*, from f. ʒ ij. to f. ℥ j.; of the *tincture*, from ♏ x. to ♏ xl.; and of the *extract*, gr. j. Antidotes.—Remove the poison from the stomach as speedily as possible. Give brandy and ammonia to counteract the depressing action of the poison on the circulation; and keep the patient in a recumbent posture to guard against syncope.

Diosma Crenata—*The Buchu.—Sex. syst. Pentandria. Monogynia. Nat. ord. Rutaceæ.* Hab.—Cape of Good Hope. Parts used.—The leaves. Composition.—*Volatile oil, bitter extractive*, &c. Effects and Uses.—Aromatic stimulant and diuretic. Chiefly used in chronic inflammation and catarrh of the bladder. Dose.—In powder ℈ j. or ʒ ſs. It is usually taken in the form of *infusion* or *tincture*.

Dorema Ammoniacum—*The Ammoniacum Plant.—Sex. syst. Pentandria. Digynia. Nat. ord. Umbelliferæ.* Hab.—Persia. Part used.—The juice which exudes from punctures in the stems. It soon concretes, and is found in commerce either in distinct tears, or in masses composed of agglutinated tears. Composition.—*Resin, gum*, and *volatile oil.* Effects.—Similar to, but less powerful than, those produced by assafœtida. Uses.—It is chiefly used as an expectorant in chronic pulmonary complaints. Dose, grs. x. to ʒ ſs.

Dorstenia Contrajerva—*The Contrajerva.—Sex. syst. Petandria. Monogynia. Nat. ord. Urticaceæ.*—Hab.—South America, and the West Indies. Part used.—The root. Composition.—It contains *volatile oil, bitter extractive*, and *resin* Effects and Uses.—Stimulant, tonic, and diaphoretic. It is occasionally used in low fevers. Dose, of the powdered root, ℈ j. or ʒ ſs.

Elettaria Cardamomum—*The Cardamom.—Sex. syst. Monandria. Monogynia. Nat. ord. Zingiberaceæ.* Hab.—East Indies. Parts used.—The seeds. Composition.—The seeds contain a large proportion of *volatile oil* and some *fixed oil.* Effects and Uses.—An agreeable aromatic and carminative, and as such frequently administered with other remedies. In the Pharmacopœia there is a *simple tincture* and a *compound tincture of cardamoms.* The latter contains, in addition to cardamoms, caraway, cochineal, cinnamon, and raisins. The dose of these is f. ʒ j. or f. ʒ ij.

Erythræa Centaurium—*Common Centaury.—Sex. syst. Pentandria. Monogynia. Nat. ord. Gentianaceæ.* Hab.—Indigenous. Parts used.—The herb or tops. They are collected when in flower. Composition.—It contains a *bitter extractive matter.* Effects and Uses.—Similar to those of gentian. Dose, in powder, ℈ j. to ʒ j.

Ether Sulphuricus—*Sulphuric Ether.* Preparation.—The following are the directions in the *London Pharmacopœia*:—"Take of rectified spirit three pounds, sulphuric acid two pounds, carbonate of potash, previously ignited, an ounce; pour two pounds of the spirit into a glass retort, add the acid to it, and mix. Afterwards place it on sand, and raise the heat so that the liquor may quickly boil, and the ether pass into a receiving vessel made cool with ice or water. Let the liquor distil until some heavier portion begins to pass over. To the liquor which remains in the retort, after the heat has subsided, pour the remainder of the spirit, that ether may distil in the same manner. Mix the distilled liquors, then pour off the supernatant portion, and add to it the carbonate of potash, shaking them frequently during an hour. Lastly, let the ether distil from a large retort, and be kept in a stoppered vessel." Theory of Etherification.—The composition of alcohol is $O_2\ C_4\ H_6$. When sulphuric acid is added to

alcohol, 2 eqs. of the acid combine with 1 eq. of alcohol to form an acid called the *sulphovinic acid*. By heat, this acid is decomposed, the 2 eqs. of sulphuric acid remain in the retort, with 1 eq. of water, abstracted from the alcohol; and ether, thus formed by the abstraction of 1 eq. of water from 1 eq. of alcohol, distils over. The composition of ether then is $O\ C_4\ H_5$; and it may be considered as the oxide of a hypothetical *radical* ethule ($C_4\ H_5$). According to this view, then, ether is an oxide of ethule; alcohol a hydrated oxide of ethule; and sulphovinic acid a hydrated bisulphate of the oxide of ethule. The sulphuric acid undergoes no other change than that of becoming diluted with the water which it abstracts from the alcohol. The rectification of ether is effected by the addition of carbonate of potash, and redistillation. The salt abstracts any water and acid which may be combined with the ether, and the latter passes over pure. Properties.—At ordinary temperatures ether is a colourless limpid liquid, having a peculiar penetrating fragrant odour, and a hot and pungent taste. The ether of the shops varies in its sp. gr. from ·733 to ·765. It is very volatile. The sp. gr. of its vapour compared with air as unity is 2·586. Ether is very combustible: it is sparingly soluble in water, but soluble in alcohol in all proportions. Effects.—The operation of ether is analogous to that of alcohol, but is more rapid and transient. In moderate doses it allays spasm and relieves flatulence. Its first effects on the cerebral functions are those of an excitant, but the subsequent ones are those of a depressing agent. In larger doses it produces intoxication, like that caused by alcohol. In excessive doses, it occasions nausea, giddiness, and stupefaction. Uses.—Ether is a valuable remedy in cases of spasm and cramp of the stomach, and in many other painful and spasmodic affections. As a stimulant in syncope, in the low stage of fever, and in various other diseases attended with great prostration. It is sometimes used as an external application for the cold produced during its evaporation. Dose, from f. ʒ fs. to f. ʒ ij. Antidotes.—Evacuate the stomach, cold affusion to the head and chest, the internal use of ammonia, and if necessary artificial respiration.

Euphorbia Officinarum—*The Officinal Euphorbium.—Sex. syst. Dodecandria. Trigynia. Nat. ord. Euphorbiaceæ.* Hab.—Africa. Part used.—The concrete milky juice, which exudes when incisions are made into the plant. Composition.—The active ingredient is an *acrid resin*. Effects.—Euphorbium is a violent acrid. Applied to the skin it produces itching, pain, and inflammation, succeeded by vesication. When swallowed it produces vomiting and purging, and, in large doses, is an irritant poison. When the vapour is inhaled it gives rise to sneezing and irritation about the eyes and nose. Uses.—It was formerly used as an emetic and purgative; but the violence and danger of its operation have led to its disuse. Mixed with other substances, it is occasionally used as a counter-irritant.

Ferrum—*Iron.* Extraction.—In Sweden, iron is extracted from magnetic iron ore; in England, principally from clay iron ore (carbonate of iron). Characteristics.—Iron dissolves in dilute sulphuric acid, with the evolution of hydrogen gas. The solution contains the proto-sulphate of iron. On the addition of potash or soda a greenish-white precipitate of the hydrated protoxide occurs: by exposure to the air this precipitate attracts oxygen, and is converted into the red or sesqui-oxide. By boiling the solution with nitric acid, we obtain the persulphate of iron, known by the blue colour produced by the ferro-cyanide of potassium, and the black by the infusion of galls. Effects and Uses.—In the *metallic state* iron is inert, but it readily oxidizes in the alimentary canal, and thus acquires medicinal power. The ferruginous compounds generally act as slight *local irritants*, especially the sulphate and the chloride. They act as astringents, and check secretion and exhalation from the parts with which they come in contact. In large doses they produce a sensation of weight and pain in the præcordia, and sometimes excite vomiting and purging. The constitutional effects of the ferruginous compounds are best seen in *anæmic* states of the system, especially in chlorotic girls, in whom the skin and lips are pale, and the cellular tissue is œdematous from a defect in the quantity and quality of the blood. In such a condition of the system, the use of iron is followed by a return of the natural colour, an increase of strength, an improvement of the appetite, and the restoration of the uterine functions, if these have been suspended, as usually happens in such cases. Iron is supposed to act in these cases by increasing the colouring matter of the blood, which naturally contains a considerable proportion of this metal. Iron has no specific emmenagogue effect; but in one case it promotes the uterine discharge, and in another checks it, according as it has been previously deficient or excessive.

Ferri Sulphas—*Sulphate of Iron.* Preparation.—Dissolve clean metallic iron in dilute sulphuric acid, and evaporate that crystals may be formed. In this process the sulphuric acid combines with the protoxide of iron, formed by the decomposition of water, the corresponding hydrogen escaping. Properties.—The crystals are of a pale-green colour: by exposure to the air oxygen is absorbed, and they acquire a yellowish-brown colour (sulphate of the sesqui-oxide of iron). They are soluble in water. Effects and Uses.—Those of the ferruginous preparations generally. It is to be preferred where there is great relaxation of the solids with immoderate discharges. Dose, from gr. j. to gr. v. in the form of pill. A most valuable combination in chlorosis consists of five grains each of sulphate of iron and extract of gentian, to be made into two pills, and taken three times a-day.

Ferri Sesqui-oxydum—*Sesqui-oxide of Iron.* Preparation.—Dissolve sulphate of iron in water, and add to it a solution of carbonate of soda; let the powder subside. Lastly, the supernatant liquor being poured off, wash what is precipitated in water and dry it. The precipitate is composed of carbonate of the protoxide of iron, but by exposure to the air during the washing and drying the carbonic acid escapes, and more oxygen combining with the protoxide converts it into a sesqui-oxide. Properties.—It is a brownish-red powder, odourless, and insoluble in water. Effects and Uses.—Those of the ferruginous compounds in general. It is but slightly astringent. It has been much given in neuralgia. Dose, from grs. x. to ʒ j.

Ferri Potassio-Tartras—*Tartarized Iron.* Preparation.—Boil together powdered bitartrate of potash, water, and moist hydrated sesqui-oxide of iron. Filter and evaporate to dryness. Composition.—One eq. of tartrate of sesqui-oxide of iron, and one eq. of tartrate of potash. Properties.—It is an olive-brown inodorous powder, with a styptic inky taste. It dissolves in about four times its weight of water. Effects and Uses.—

These agree with those of the other compounds of iron. It it is but slightly astringent. Dose, grs. x. to ʒ fs.

Ferri Iodidum—*Iodide of Iron.* Preparation.—Mix iodine with water, and add iron filings. Heat them in a sand-bath, and when it has acquired a greenish colour, pour off the liquor, and evaporate that the salt may be dried. Properties.—It is an opaque iron-grey crystalline mass, with a faint metallic lustre, and a styptic taste. It is soluble in both water and alcohol. It readily attracts oxygen from the air, and forms sesqui-oxide and sesqui-iodide of iron. Effects and Uses.—This compound is supposed to combine the effects of iron and iodine, and is much used in scrofula and in some cases of secondary syphilis. Dose, grs. iij. to grs. x.

Ferri Sesqui-chloridi Tinctura—*Tincture of Sesqui-chloride of Iron.* Preparation.—Pour a pint of hydrochloric acid upon six ounces of sesqui-oxide of iron in a glass vessel, and digest for three days, frequently shaking; then add three pints of rectified spirit and strain. Properties.—This tincture has a reddish-brown colour, a sour styptic taste, and an odour of hydrochloric ether. It re-acts on vegetable colours as an acid. Composition.—It consists of rectified spirit, a small portion of hydrochloric ether, hydrochloric acid, and sesqui-chloride of iron. Effects and Uses.—This preparation is a powerful astringent and styptic, and, in large doses, irritant. Its constitutional effects are the same as those produced by other ferruginous preparations, and, like them, it colours the fæces black: it is besides a powerful diuretic, and is useful in arresting hæmorrhage from the bladder or kidneys. As a *styptic* it is sometimes used to arrest bleeding from small vessels. Dose, from ♏ x. to ʒ j. Antidotes.—The same as for the mineral acids.

Ferula Assafœtida—*The Assafœtida.—Sex. syst. Pentandria. Digynia. Nat. ord. Umbelliferæ.* Hab.—Persia. Part used.—The concrete juice, which is obtained by making incisions into the upper part of the root. It exists in tears and in lumps. It is fusible and inflammable. Its taste is acrid and bitter, and its odour alliaceous. Composition.—*Resin, gum,* and *volatile oil* are the chief constituents. Effects and Uses.—Assafœtida is a stimulant, expectorant, and antispasmodic. It is useful in spasmodic and convulsive hysterical affections, in flatulent colic, and in chronic catarrh. Dose, grs. v. to ʒ j. It may be given in the form of pill, or made into an emulsion with water, or in the form of *tincture.*

Ferula? *An uncertain species yielding Sagapenum.*—Sagapenum exists in the form of tears, or in masses. It has an aromatic and agreeable odour similar to, though more pleasant than, that of galbanum. Composition.—*Gum, resin,* and *volatile oil.* Effects and Uses.—The same as those of assafœtida. Dose, gr. v. to ʒ fs.

Galbanum Officinale—*The Officinal Galbanum.*—The plant yielding this gum is not known, nor is the precise country in which it is produced. Galbanum occurs in the form of tears and of lumps. It has a peculiar balsamic odour, and a hot, acrid, and bitter taste. Composition.—*Volatile oil, gum,* and *resin.* Effects and Uses.—The same as those of assafœtida. Dose, grs. x. to ʒ fs., in the form of pill or emulsion.

Galipea Cusparia and G. Officinalis—*The Cusparia.—Sex. syst. Diandria. Monogynia. Nat. ord. Rutaceæ.* Hab.—South America. Part used.—The bark. It occurs in flat pieces and quills, of various sizes, covered with a yellowish-grey epidermis. The internal surface is brownish, and easily separable into laminæ. Composition.—It contains *volatile oil, bitter extractive,* and *resin.* Effects and Uses.—Cusparia or Angustura bark is a powerful aromatic and stimulant tonic. It is not astringent; but in full doses produces nausea and purging. It may be used in all cases for which cinchona is administered, although it is not equally efficacious as an antiperiodic remedy. Dose, in powder, from grs. x. to ʒ fs. The *infusion* is the most eligible form.

Gallæ.—Vide *Quercus.*

Gentiana Lutea—*Common or Yellow Gentian.—Sex. syst. Pentandria. Digynia. Nat. ord. Gentianaceæ.* Hab.—Alps of Austria and Switzerland. Part used.—The root. Composition.—A *volatile odorous principle, gentisin, bitter principle, pectin,* and *sugar.* Effects and Uses.—Gentian is a simple bitter tonic, without being astringent or very stimulant. In large doses it relaxes the bowels. It is a valuable remedy in dyspepsia, and in many other diseases marked by weakness and debility, but unattended by fever or irritation of the stomach and intestines. It is usually given in the form of *infusion, tincture,* or *extract.*

Granati Cortex.—Vide *Punica Granatum.*

Guaiacum Officinale—*The officinal Guaiacum.—Sex. syst. Decandria. Monogynia. Nat. ord. Zygophyllaceæ.* Hab.—St. Domingo and Jamaica. Parts used.—The wood and the resin. The resin is obtained by natural exudation from the stem; or by exudation from wounds artificially made in different parts of the tree; or by heating billets placed on the fire, with a hole burnt in the end of each, from which the melted resin exudes, and is collected. It is also obtained in small quantities by boiling the wood in water with common salt. The resin swims at the top, and may be skimmed off. Guaiacum occurs in tears and in masses. It has a greenish-brown colour, and a brilliant resinous fracture; it has a balsamic odour, and when chewed leaves a burning sensation in the throat. Composition of Guaiacum.—It is essentially a *peculiar resin,* mixed with some extractive and other impurities. Effects and Uses.—Guaiacum is an acrid stimulant, diaphoretic, expectorant, and alterative. In large doses it produces vomiting, purging, and headache. It is used in chronic rheumatism, in some forms of gout, in chronic skin diseases, and as a remedy for some forms of secondary syphilis. Dose, of powdered resin, grs. x. to ʒ fs. In the Pharmacopœia there is a *mixture,* a *tincture,* and a *compound tincture of guaiacum.*

Hæmatoxylon Campechianum—*The Logwood.—Sex. syst. Decandria. Monogynia. Nat. ord. Leguminosæ.* Hab.—Campeachy. Part used.—The wood. As imported it consists only of the heart-wood. The logs are externally of a dark colour; internally, red. Composition.—*Volatile oil, hæmatin, resin, tannin,* &c. Effects and Uses.—Logwood is a mild astringent, and as such is used in diarrhœa, dysentery, and hæmorrhages. It is used in the form of *decoction* or *extract;* the dose of the latter is from grs. x. to ʒ fs.

Hebradendron Cambogioides—*The Gamboge Hebradendron.—Sex. syst. Monœcia. Monadelphia. Nat. ord. Guttiferæ.* Hab.—Ceylon. This is the plant which yields Ceylon gamboge. The Siam gamboge is yielded by an unascertained species; probably a species of Hebradendron. Preparation.—Siam gamboge is obtained by breaking the leaves and small branches, when a milky juice exudes, and is collected on the leaves of the tree, or in cocoa-nut shells, and from thence is transferred into large flat earthen vessels, where it is allowed to harden, and is afterwards enve

loped in leaves. The cylindrical or pipe variety receives its form by being run into the joints of the bamboo while it is in the liquid state. In Ceylon, gamboge is obtained by wounding the bark of the tree in various places. The juice which exudes hardens in the sun. The Siam gamboge only is met with in commerce. This occurs in two forms,—the *pipe* and the *cake* gamboge. Composition.—It contains *gambogic acid* and *gum*; the former of these is the active principle. Effects and Uses.—Gamboge is a powerful hydragogue cathartic. In excessive doses it acts as an acrid poison. It is used in obstinate constipation, in cerebral affections, in dropsies, and occasionally as an anthelmintic. Dose, from gr. j. to gr. vj. in the form of pill.

Helleborus Niger—*The Black Hellebore.—Sex. syst. Polyandria. Polygynia. Nat. ord. Ranunculaceæ.* Hab.—Middle and southern parts of Europe. Part used.—The root, which consists of two parts; the rhizome or root-stock, and the fibres arising from it. Composition.—Its activity depends on the presence of an *acrid oil*. Effects and Uses.—Black hellebore is a local irritant. Taken internally it is a violent purgative and emmenagogue; in large doses it produces vomiting, and symptoms of inflammation of the intestinal canal. It is but little employed; but it may be cautiously used in some affections of the nervous system, as in mania, as an emmenagogue, and in dropsy. Dose, of the powdered root, grs. iij. to ℈j. *Tinctura Hellebori.* (Hellebore bruised, ℥ v.; proof spirit, O ij Macerate for fourteen days, and strain). Dose, f. ʒ fs. to f. ʒ j.

Helonias Officinalis—*The Cebadilla.—Sex. syst. Hexandria. Trigynia. Nat ord. Melanthaceæ.* Hab.—Mexico. Parts used.—The seeds. They are two or three lines long, scimitar-shaped, dark brown. They have little odour, but a bitter, acrid, persistent taste. Composition.—The medical properties of the seeds depend on the presence of the alkali *veratria*. Effects.—Its action is similar to that of white hellebore, but more violent. Use.—It is introduced into the Pharmacopœia as the source from which veratria is obtained.

Humulus Lupulus—*The Hop Plant.—Sex. syst. Diœcia. Pentandria. Nat. ord. Urticaceæ.* Hab.—Indigenous. Parts used.—The strobiles or catkins. Composition.—*Volatile oil*, *resin*, and a *bitter principle* (*lupuline*). Effects and Uses.—The odorous emanations are said to possess narcotic properties; and a pillow of hops has been used in mania and other cases in which restlessness prevails. Internally hops produce the effects of an aromatic tonic, and they have perhaps *very slight* sedative and soporific properties. The chief consumption of hops is in the manufacture of beer. They may be given in the form of *powder*, *infusion*, *tincture*, or *extract*.

Hydrargyrum—*Quicksilver or Mercury.* Preparation.—It is obtained from native cinnabar (bisulphuret of mercury). The cinnabar is mixed with caustic lime, and distilled in iron retorts. The lime abstracts the sulphur, and the disengaged mercury distils over. Characteristics.—In its metallic state mercury is recognized by its liquidity, and by its volatility. The salts of mercury, when heated with potash or soda, are reduced, and globules of metallic mercury are obtained. Solutions of the salts placed in contact with a bright surface of copper, leave a silvery stain, which disappears when heated to redness. Solutions of the proto-salts of mercury yield with caustic potash or soda a grey or black precipitate, and with iodide of potassium a greenish or yellow precipitate. Solutions of the per-salts yield with potash or soda a yellow or reddish precipitate, and with iodide of potassium a scarlet one. Effects.—Metallic mercury, when swallowed, is inert, unless it becomes oxidized, as it may do in the alimentary canal. Applied externally, it has sometimes produced salivation. Mercurial vapours, when inhaled and applied to the surface of the body, produce most injurious effects. Thus gilders and men employed in quicksilver mines are subject to an affection called the *shaking palsy*. It commences with unsteadiness of the limbs, and frequently goes on to complete palsy of the whole body. Exposure to the vapour of mercury is sometimes followed by salivation and other constitutional effects. The *mercurial compounds* have the local action of irritants, and some of them act as energetic caustics. Internally, in small doses, the compounds of mercury are considered to have an *alterative* action. Moderate doses increase most of the secretions, especially those of the digestive organs. The alvine evacuations become more liquid, and contain a larger proportion of bile. The urine is slightly increased in quantity, and the cutaneous exhalation is augmented. If small doses are long continued, or larger doses are given, the most marked influence is exerted on the mouth and salivary glands. The gums become swollen and red; there is pain and swelling about the jaws, followed by a greatly increased flow of saliva. In some cases the inflammation of the parts about the mouth goes on to ulceration and sloughing; this may arise from the administration of large quantities, or from a peculiar susceptibility of the influence of small doses. When the system is under the influence of mercury, the patient complains of a coppery taste in the mouth, and the breath has a peculiar fœtid odour. Some bad effects occasionally follow the medicinal use of mercury: of these the most common are—excessive salivation, violent purging, ulceration, and sloughing of the mouth, and sometimes necrosis of the bones of the jaw. A cutaneous eruption is occasionally induced by the use of mercury; the most common form is the *eczema mercuriale*. In excessive doses, some of the mercurial compounds act as irritant poisons, and if the symptoms continue more than twenty-four hours, the above-mentioned constitutional effects usually make their appearance. Uses.—The mercurial compounds are used, in small doses, as alteratives in various chronic diseases. In moderate doses as purgatives, usually combined with some vegetable purgative. The constitutional effects of mercury are induced in the treatment of inflammations, especially of those kinds of inflammation which are attended with an abundant effusion of coagulable lymph (the *adhesive inflammation*); since it is most satisfactorily ascertained that the condition which mercury induces is directly opposed to the adhesive inflammation. In certain forms of syphilis mercury is a most valuable remedy; the cases in which it is applicable can only be learnt by a careful study of the disease. Modern observation has sufficiently shown that mercury is by no means essential for the cure of syphilis.

The preparations of mercury are very numerous; we must content ourselves with a brief notice of the most important.

Hydrargyri Bichloridum—*Bichloride of Mercury.* Preparation.—Two pounds of mercury are boiled with three pounds of sulphuric acid, to dryness. We thus obtain a bi-persulphate of mercury; the dry salt is then mixed with a pound and a half of chloride of sodium, and sublimed. We thus obtain sulphate of soda and

bichloride of mercury; the latter sublimes. PROPERTIES.—It is usually seen in a semi-transparent crystalline mass. The taste is acrid and coppery. It is soluble in about three times its weight of boiling and in about twenty times its weight of cold water. It is soluble in alcohol and in ether. CHARACTERISTICS.—Iodide of potassium gives, with a solution of bichloride, a scarlet precipitate of the biniodide of mercury; the colour disappears if there be an excess of either salt. This test is quite characteristic. COMPOSITION.—1 eq. of mercury, 2 eqs. of chlorine. EFFECTS.—In medicinal doses it produces the effects of the mercurial preparations generally. In somewhat larger doses it produces symptoms of chronic inflammation of the stomach and intestines. In excessive doses it is a most violent irritant poison, the symptoms being much the same as those produced by arsenic. USES.—Its chief use is as an alterative in chronic diseases. DOSE.—From gr. $\frac{1}{16}$th to gr. $\frac{1}{8}$th. ANTIDOTES.—The best antidote for this salt is *albumen*, with which it forms an insoluble compound. The white of one egg is sufficient to neutralize four grains of the poison.

HYDRARGYRI CHLORIDUM—*Chloride of Mercury (Calomel)*. PREPARATION.—Mercury and sulphuric acid are boiled together in the same manner as for the preparation of the bichloride. The bi-persulphate is then mixed with two pounds of metallic mercury, and subsequently with a pound and a half of chloride of sodium, and sublimed. We thus obtain sulphate of soda and a protochloride of mercury. PROPERTIES.—Calomel crystallizes in the form of the right square prism. It is white, volatile, insoluble in water and in alcohol. CHARACTERISTICS.—This is known to be the protochloride by its insolubility in water, and by the black precipitate of the protoxide which it gives with lime-water; while the supernatant liquor, on the addition of nitrate of silver, gives evidence of the presence of chlorine. COMPOSITION.—1 eq. of mercury, 1 eq. of chlorine. EFFECTS.—Those of the mercurial compounds generally. It is not caustic, nor is it very poisonous even when given in large doses. USES.—Calomel is the most used of any mercurial compound; it is given as an alterative, purgative, sialagogue, anthelmintic, and in large doses as a sedative in cholera. DOSE.—The ordinary doses are from gr. ſs. to grs. v. The celebrated PLUMMER's pill is composed of *chloride of mercury*, ʒ ij., *oxysulphuret of antimony*, ʒ ij., *guaiacum resin* powdered, ℥ ſs. *treacle*, ʒ ij. It is much used as an alterative. Dose, grs. v. to grs. x.

HYDRARGYRUM CUM CRETA—*Mercury with Chalk*. PREPARATION.—It is prepared by rubbing three ounces of mercury with five ounces of chalk, until globules are no longer visible. PROPERTIES.—It is a greyish powder, which effervesces on the addition of acetic acid, yielding a solution of lime. COMPOSITION.—It consists of chalk, with metallic mercury, and a small portion of protoxide. EFFECTS AND USES.—It is valuable as a mild alterative and a purgative for infants. DOSE.—For adults, grs. v. to ℈ j.; for children, grs. ij. or grs. iij.

HYDRARYGRI PILULÆ—*Pills of Mercury*—(*Blue Pills*). PREPARATION.—Rub two drachms of purified mercury with three drachms of confection of roses until globules are no longer visible, then add a drachm of powdered liquorice-root. EFFECTS AND USES.—It is much used as an alterative and purgative. DOSE, grs. v.

HYDRARGYRI UNGUENTUM—*Ointment of Mercury*. PREPARATION.—It is prepared by rubbing two pounds of mercury with an ounce of suet and twenty-three ounces of lard until globules are no longer visible. EFFECTS AND USES.—When applied to the surface of the body it becomes absorbed, and produces the constitutional effects of mercury. It is used chiefly as a means of affecting the constitution, especially when from irritability of the digestive organs, or from some other cause, the internal use of mercury is not admissible. Half a drachm or a drachm may be rubbed on the skin night and morning.

HYDRARGYRI NITRICO OXYDUM—*Nitric oxide of Mercury*. PREPARATION.—Mercury is dissolved in nitric acid, and the solution evaporated to dryness; the residue is reduced to powder, and heated until red vapours cease to arise. PROPERTIES.—It occurs in bright red crystalline grains or scales. When quite free from nitrate of mercury it is insoluble in water. EFFECTS AND USES.—Its local action is that of an irritant. In the form of ointment it is a valuable stimulant, and is often applied to indolent ulcers and to some forms of cutaneous disease.

The above are the preparations of mercury in most frequent use. There are others of less importance, such as the following:—*Hydrargyri Iodidum; H. Biniodidum; H. Oxydum; H. Binoxydum; H. Bisulphuretum; H. Ammonio-Chloridum.*

HYOSCYAMUS NIGER—*The Henbane.*—*Sex. syst. Pentandria. Monogynia. Nat. ord. Solanaceæ.* HAB.—Indigenous. PARTS USED.—The leaves and seeds. COMPOSITION.—The properties depend on a vegetable alkali, *hyoscyamia*. EFFECTS AND USES.—The effects of henbane very closely resemble those of belladonna and stramonium; it however differs from them in this, that large doses seldom produce symptoms of irritation of the intestinal canal. USES.—Hyoscyamus is used to alleviate pain, to remove spasm, and to promote sleep. For these purposes it is less to be relied on than opium; but it may be advantageously employed when opium is found to produce headache or other unpleasant symptoms. It does not, like opium, stimulate the vascular system, nor does it produce constipation. DOSE.—The powdered leaves may be given in doses of from grs. iij. to grs. x. The *extract* and *tincture* are the preparations most in use; the dose of the former is from gr. v. to ℈ j.; of the latter f. ʒ ſs. to f. ʒ ij. ANTIDOTES.—The same as for opium.

INULA HELENIUM—*Elecampane.*—*Sex. syst. Syngenesia. Polygamia. superflua. Nat. ord. Compositæ.* HAB.—Indigenous. PART USED.—The dried root. COMPOSITION.—*Volatile oil*, *elecampane camphor*, *resin*, *inulin*, and *bitter extractive*. EFFECTS AND USES.—It is an aromatic tonic, and is slightly diaphoretic, diuretic, and expectorant; it is seldom used. DOSE.—Of the powdered root, ℈ j. to ʒ ij.

IODINUM—*Iodine*. PREPARATION.—Iodine is obtained from the ashes of the *Fucoideæ* (a tribe of sea-weeds); the ashes are called *kelp*. Kelp contains several soluble salts of potash, soda, and magnesia; and amongst others iodide of potassium or sodium; this is separated from the other salts by repeated crystallization; the iodide being more soluble, remains in solution. The liquor is then introduced into a stone-ware still, sulphuric acid and the binoxide of manganese are added, and heat is applied. The iodide is decomposed, sulphate of potassa or soda remains in the retort with the sulphate of the protoxide of manganese; and iodine distils over. PROPERTIES.—Iodine is usually met with

in soft micaceous scales, having a greyish colour, a disagreeable odour, and a hot acrid taste. It is volatile, its vapour having a violet colour. It is soluble in alcohol and in ether, and slightly so in water. CHARACTERISTICS.—In its free state iodine is distinguished by its forming an intense blue colour with starch. EFFECTS.—In small doses iodine is considered as an alterative. In moderate doses, it increases the secretion of urine and of intestinal mucus; probably, too, that of the bile and of the pancreatic fluid; in some cases it produces salivation. It has a remarkable power of increasing the activity of the absorbents. Thus glandular enlargements frequently disappear under its use, and in some very rare cases, the mammæ of the females and the testicles of the male are said to have become absorbed. In large doses *iodine* acts as an irritant poison. USES.—Iodine is used with much benefit in *bronchocele*, in scrofula, and in various chronic diseases of the viscera. It is supposed to be occasionally efficacious as an emmenagogue. It is an useful remedy in some forms of the venereal disease. DOSE, about gr. fs. It is seldom given alone, but usually in solution with iodide of potassium. ANTIDOTES.—In the event of poisoning by iodine, promote vomiting by the use of tepid demulcent drinks, especially such as contain starch, so that an iodide of starch may be formed, this having but little local action.

IPOMÆA JALAPA—*The Jalap.—Sex. syst. Pentandria. Monogynia. Nat. ord. Convolvulaceæ.* PART USED.—The dried tubers: they vary in size from that of the fist to that of a nut, and are covered with a thin brown, wrinkled cuticle. COMPOSITION.—The medicinal virtues of jalap reside in a *peculiar resin.* EFFECTS AND USES.—Jalap is a powerful purgative, producing copious liquid stools, and, when judiciously administered, it is both safe and efficacious. It very useful in obstinate constipation unattended with irritation or inflammation of the alimentary canal; as a vermifuge; in cerebral diseases, and in some forms of dropsy. DOSE.—From grs. v. to ℈j. In the Pharmacopœia there is a tincture and an extract.

JUNIPERUS COMMUNIS—*The Common Juniper.—Sex. syst. Diœcia. Monadelphia. Nat. ord. Coniferæ.* HAB.—North of Europe. PARTS USED.—The fruit and tops. The berries are about the size of a pea, of a blackish purple colour, covered by a glaucous bloom; they contain three seeds. COMPOSITION.—The berries contain *volatile oil, resin, wax,* and *sugar.* EFFECTS AND USES.—Juniper berries and tops are stimulant diuretics, and as such are used in dropsies and in some chronic diseases of the bladder. DOSE.—Of the berries one or two drachms.

JUNIPERUS SABINA—*Common Sabine.* HAB.—Middle and southern parts of Europe. PARTS USED.—The tops. COMPOSITION.—The most important constituents are *volatile oil* and *resin.* EFFECTS AND USES.—The local action of sabine is that of an irritant and rubefacient: taken internally, it acts as a stimulating diuretic and emmenagogue. In large doses it is an irritant poison, and in some cases has produced abortion. It is sometimes employed as an emmenagogue. The cerate is used to keep open blisters.

KINO.—Vide *Pterocarpus.*

KRAMERIA TRIANDRIA—*The Ratany.—Sex. syst. Tetrandria. Monogynia. Nat. ord. Polygaleæ.* HAB.—Peru. PART USED.—The root. COMPOSITION.—It contains about 40 per cent. of *tannin.* EFFECTS AND USES.—It is a powerful astringent and tonic, and is used in diarrhœa and in passive hæmorrhages. DOSE.—grs. x. to ʒ fs.

LACTUCA SATIVA—*The Garden Lettuce.—Sex. syst Syngenesia. Polygamia Æqualis. Nat. ord. Compositæ.* HAB.—Extensively cultivated in Europe. PART USED.—The inspissated juice called *Lactucarium.* It exudes from incisions made in the flowering stem, and concretes. COMPOSITION.—Lactucarium contains *bitter extractive, wax, resin,* and *caoutchouc.* EFFECTS AND USES.—It is said to possess anodyne and sedative properties, and is used in some cases when opium disagrees. It is not a medicine of much value. DOSE.—grs. iij. to grs. v.

LAVANDULA VERA—*Common Lavender.—Sex. syst. Didynamia, Gymnospermia. Nat. ord. Labiatæ.* HAB.—South of Europe. PARTS USED.—The flowers. COMPOSITION.—They contain *volatile oil* and *tannin.* EFFECTS AND USES.—Carminative, slightly stimulant, and tonic. Chiefly used as adjuncts to other medicines. In the Pharmacopœia there is an *oil,* a *spirit,* and a *compound tincture of lavender.*

LINUM USITATISSIMUM—*Common Flax.—Sex. syst. Pentandria. Pentagynia. Nat. ord. Linaceæ.* HAB.—Indigenous. PARTS USED.—The seed, commonly called linseed. COMPOSITION.—The nucleus contains a large quantity of *fixed oil,* while the husk abounds in *mucilage.* EFFECTS AND USES.—Linseed is emollient and demulcent, and is used to allay irritation in the form of *infusion, oil,* or *cataplasm.* The cataplasm is made by adding to powdered linseed as much boiling water as may be sufficient to make it of a proper consistence.

LOBELIA INFLATA—*Bladder-inflated Lobelia; Indian Tobacco.—Sex. syst. Pentandria. Monogynia. Nat. ord. Lobeliaceæ.* HAB.—North America. PART USED.—The dried herb. It is compressed into oblong cakes. The dried herb has a pale greenish yellow colour, a nauseous smell, and a burning acrid taste, similar to that of tobacco. COMPOSITION.—Dr. Pereira states that it contains a *volatile acrid principle, an acid,* and *resin.* EFFECTS AND USES.—In small doses it acts as an expectorant and a diaphoretic. In full doses it acts powerfully as an emetic, causing extreme nausea, and great general relaxation. In excessive doses it is an acro-narcoctic poison. Its action is very similar to that of the common tobacco. It has been chiefly given in spasmodic asthma; in strangulated hernia it may be used instead of tobacco. DOSE.—Of the powder, as an expectorant, from gr. j. to grs. v.; as an emetic, from grs. x. to ℈j. An alcoholic or an ethereal tincture may be used. ANTIDOTE.—The same as for tobacco.

MAGNESIÆ SULPHAS—*Sulphate of Magnesia.* PREPARATION.—It is obtained from *bittern* or from *dolomite.* Bittern is the mother-liquor of sea water from which the chloride of sodium has been separated by crystallization. It contains chloride of magnesium and sulphate of magnesia. The sulphate may be obtained by evaporation. Dolomite, or magnesian limestone, is composed of carbonate of lime and carbonate of magnesia. When sulphuric acid is added to this, carbonic acid escapes, and sulphate of magnesia and sulphate of lime are formed. These two salts are separated from each other by crystallization, the sulphate of lime being the least soluble. The properties of sulphate of magnesia or Epsom salts are sufficiently well known. EFFECTS AND USES.—It is a mild antiphlogistic purgative, promoting the secretions as well as the vermicular motion of the intestinal canal. It is much used in febrile and

inflammatory diseases, and as an ordinary purgative in constipation. Dose.—From ʒ ij. to ℥ j.

Magnesia—*Magnesia.* Preparation.—Obtained by heating the subcarbonate, so as to drive off the carbonic acid. Properties.—It is a fine light, white powder, odourless and tasteless. It is but slightly soluble in water. Effects and Uses.—It neutralizes the free acids of the stomach, and in full doses it acts as a laxative. If long continued, it tends to render the urine alkaline. When taken in large quantities, for a very long period, it has sometimes accumulated in the intestines, and produced unpleasant and even dangerous consequences. It is given as an antacid in dyspepsia, and in the uric acid diathesis; as a laxative in diseases of children; and for adults when a very mild aperient is required. Dose.—For adults, from ℈ j. to ʒ j.; for infants from grs. ij. to grs. x.

Magnesiæ Subcarbonas—*Subcarbonate of Magnesia.* Preparation.—Dissolve separately four pounds of sulphate of magnesia, and four pounds and eight ounces of carbonate of soda, in two gallons of water, and strain: then mix the liquors, and boil for a quarter of an hour, constantly stirring with a spatula: lastly, having poured off the liquor, wash the precipitated powder with boiling distilled water, and dry it. In this process double decomposition takes place. Carbonate of magnesia, being insoluble, precipitates, and sulphate of soda remains in solution. Some bicarbonate of magnesia is formed, and remains in solution with the soda, consequently the precipitate is a subcarbonate of magnesia, its composition being 4 eqs. magnesia and 3 eqs. carbonic acid. It is nearly insoluble in water, but readily dissolves in carbonic acid water. Effects, Uses, and Doses.—The same as those of the magnesia.

Maranta Arundinacea—*The Arrow-Root.—Sex. syst. Monandria. Monogynia. Nat. ord. Marantaceæ.* Hab.—West Indies. Part used.—The fecula obtained from the tubers. The rhizomes are dug up when they are a year old, washed, beaten to a pulp, and agitated in water, so as to separate the fibrous from the feculaceous part. The milky fluid is strained through coarse linen, and left at rest until the fecula subsides, when the supernatant fluid being decanted, the fecula is well washed in fresh portions of water, and dried in the sun. Effects and Uses.—Arrow-root forms a mild demulcent nutriment for children and for the sick.

Melaleuca Minor—*The Cajuput.—Sex. syst. Polyadelphia. Icosandria. Nat. ord. Myrtaceæ.* Hab.—Moluccas. Part used.—The volatile oil extracted from the leaves. Effects and Uses.—Cajuput oil is a powerful anti-spasmodic diffusible stimulant and sudorific. It is used in cramp of the stomach and in flatulent colic. Dose.—From ♏ j. to ♏ x.

Mentha Viridis—*Spearmint.—Sex. syst. Didynamia. Gymnospermia. Nat. ord. Labiatæ.* Hab.—Indigenous. Part used.—The whole herb. Composition.—*Volatile oil, resin,* and a *bitter principle.* Effects and Uses.—Aromatic, carminative, and mildly stimulant. It is chiefly used as a flavouring ingredient. Pharmacopœial preparations, *oleum, spiritus,* and *aqua.*

Mentha Piperita—*The Peppermint.*

Mentha Pulegium—*The Pennyroyal.*—The composition, effects, and uses of these species are the same as those of the Mentha Viridis.

Menyanthes Trifoliata—*The Buck-bean.—Sex. syst. Pentandria. Monogynia. Nat. ord. Gentianaceæ.* Hab.—Indigenous. Part used.—The whole herb. Composition.—Its active principle is a *bitter extractive.* Effects and Uses.—Tonic, and, in large doses, cathartic. It is seldom used.

Mezerei Cortex.—Vide *Daphne.*

Momordica Elaterium—*The Squirting Cucumber.—Sex. syst. Monœcia. Syngenesia. Nat. ord. Cucurbitaceæ.* Hab.—South of Europe: cultivated at Mitcham, in Surrey, and at Ampthill, in Bedfordshire. Part used.—Elaterium is a sediment deposited from the juice immediately surrounding the seeds. Preparation.—The cucumbers should be gathered when as nearly ripe as possible; they should be cut through longitudinally, and the juice allowed to strain through a fine sieve. After standing a few hours a sediment is formed, from which the clear liquor is to be poured off; it is then to be thinly spread on fine linen, and exposed to the air to dry. If pressure is employed the elaterium becomes mixed with inert matters, which render its strength uncertain. Good elaterium is friable, has a pale greenish-grey colour, and an animal odour; thrown into water it swims; it does not effervesce in dilute hydrochloric acid; touched with tincture of iodine it gives no evidence of the presence of starch. English elaterium is the best. The Maltese elaterium is largely adulterated with chalk and starch. Composition.—The active principle is *elaterin,* of which good elaterium contains 26 per cent. It is a crystalline solid, insoluble in water, but soluble in hot alchohol. Effects and Uses.—Elaterium is a violent hydragogue purgative, producing copious watery evacuations. Its chief use is for removing the fluid of dropsies. Dose.—The dose of good elaterium is from gr. $\frac{1}{8}$ to gr. $\frac{1}{4}$.

Moschus Moschiferus—*The Musk Animal.—Cl. Mammalia. Ord. Ruminantia.* Part used.—Musk is contained in a sac situated in front of the prepuce; the musk sac exists only in the male animal. Hab.—Asia. Adulteration.—The Chinese adulterate musk, and even form artificial musk by a mixture of blood and ammonia with a small quantity of musk. The analysis of musk is unsatisfactory. Effects and Uses.—Musk is a stimulant and antispasmodic, and is sometimes used in low fevers, and in some convulsive diseases, as hysteria. Dose.—From grs. viij. to grs. xv. It may be given in substance or suspended in water by means of saccharine or mucilaginous substances.

Mucuna Pruriens—*The Cowhage, or Cow-itch.—Sex. syst. Diadelphia. Decandria. Nat. ord. Leguminosæ.* Hab.—West Indies. Parts used.—The bristly stinging hairs with which the pods are clothed. Effects and Uses.—The hairs are used as an anthelmintic; they are supposed to act mechanically by irritating the worms and compelling them to shift their quarters. They are usually given in treacle or honey.

Myristica Moschata.—*The Nutmeg-Tree.—Sex. syst. Diœcia. Monadelphia. Nat. ord. Myristaceæ.* Hab.—Moluccas. Composition. The nutmeg contains a large proportion of *volatile oil.* Effects and Uses.—In moderate doses nutmegs are aromatic stimulants and antispasmodics. In large doses they are narcotic, causing giddiness, delirium, and stupor. They are chiefly used for flavouring, and as a corrigent. Dose.—℈ j. or ʒ ſs. The oil is given in doses of from ♏ j. to ♏ v.

Myrospermum Peruiferum — *The Quinquino.—Sex. syst. Decandria. Monogynia. Nat. ord. Legumino-*

sæ. Hab.—South America. Part used.—The balsam, which exudes when incisions are made into the bark of the tree. It is a transparent reddish-brown liquid, of the consistence of treacle, having an agreeable odour and a warm bitter taste. Composition.—Balsam of Peru contains an *oil*, *cinnamic acid*, and *resin*. Effects and Uses.—It is a stimulating expectorant, and is useful in chronic catarrh, and in some forms of asthma. Applied to indolent ulcers it sometimes has a good effect in cleansing them. Dose.—f. ʒ ſs. to f. ʒ j.

Myrospermum Toluiferum—*The Balsam of Tolu-Tree.* Hab.—South America. The balsam is obtained by making incisions into the bark of the tree; when recent it is soft and tenacious, but by age it becomes hard and brittle, like resin. It is transparent, has a reddish-brown colour, and a most fragrant odour. Composition, Effects, and Uses.—Similar to those of the balsam of Peru.

Myrrha.—Vide *Balsamodendron.*

Nicotiana Tabacum—*The Tobacco Plant.* —*Sex. syst. Pentandria. Monogynia. Nat. ord. Solanaceæ.* Hab.—America. Parts used.—The leaves. Composition.—Tobacco leaves contain *a volatile acrid principle* (*nicotina*) and a *concrete volatile oil.* Effects.—In small doses tobacco produces nausea, giddiness, and an increased flow of urine. In larger doses it causes vomiting and purging, with great languor and relaxation of the muscles, extreme anxiety, and a tendency to faint. In excessive doses the effects are the same, but more violent in degree. The smoking of tobacco by those unaccustomed to it produces the same symptoms as those arising from its introduction into the stomach: in the form of enema the effects are precisely the same. Uses.—Tobacco is used in cases of colic, strangulated hernia, and constipation; its efficacy in those cases depending on its power of relaxing the muscular fibres, and on its purgative properties. It has also been used in tetanus and some other spasmodic diseases. It is administered in the form of enema; but the dangerous collapse which it sometimes induces renders most practitioners extremely cautious of this drug, and it is not frequently used. In the London Pharmacopœia the *enema tabaci* is ordered to be made by infusing one drachm of tobacco in a pint of boiling water; not more than one-third of this enema should be administered at a time. Antidotes.—In a case of poisoning by tobacco give coffee, and, if necessary, brandy and ammonia.

Nux Vomica.—Vide *Strychnos.*

Olea Europæa—*The European Olive.* —*Sex. syst. Diandria. Monogynia. Nat. ord. Oleaceæ.* Hab.—Levant, Barbary, south of Europe. Part used.—The oil expressed from the fruit. The oil resides in the pericarp, and is obtained by pressing the olives. Effects and Uses.—Like all the fixed oils, olive oil is extremely nutritious, but difficult of digestion. In large doses it acts as a laxative. It is sometimes given in cases of irritant poisoning to involve acid substances and protect the stomach from their action. Its chief use is for the formation of liniments and ointments.

Opium.—Vide *Papaver.*

Opoponax Chironium—*The Opoponax.*—*Sex. syst. Pentandria. Monogynia. Nat. ord. Umbelliferæ.* Hab.—South of Europe. Part used.—The gum resin. It is probably obtained by incisions into the root: a milky juice exudes which, by drying, forms opoponax. Composition, Effects, and Uses.—Similar to those of the other fetid gum-resins.

Papaver Rhœas—*The Red Poppy.*—*Sex. syst. Polyandria. Monogynia. Nat. ord. Papaveraceæ.* Hab.—Indigenous. Parts used.—The petals. Composition.—The most abundant constituent is a red colouring matter. Effects and Uses.—The red poppy is scarcely if at all narcotic; its only use is as a colouring agent. In the Pharmacopœia there is a *Syrupus Rhœados.*

Papaver Somniferum—*The Somniferous or White Poppy.*—There are two varieties of this species, the *white* and the *black.* Hab.—Asia and Egypt. Parts used.—The capsules, and the opium obtained from the capsules: the capsules should be gathered before they are quite ripe, otherwise they lose much of their activity. Preparation of Opium.—Opium is obtained by making incisions into the half-ripe capsules; a white substance immediately flows out and collects in tears on the edges of the cuts. In this state the field is left for twenty-four hours, and on the following day the opium is collected by large blunt knives. Each head furnishes opium once only, and that to the extent of a few grains. In commerce several varieties of opium are known. The Smyrna opium is the best and most abundant. There is also the *Constantinople, Egyptian, Persian, Indian,* as well as the *English, French, and German opium.* Opium exists in masses of variable size; some kinds appear to be made up of agglutinated tears, while others have more the uniform appearance of an extract. It is generally of a reddish-brown colour, having a strong unpleasant odour, and a bitter, acrid, nauseous taste. Composition.—The following are stated to be the constituents of opium: *morphia, narcotina, codeia, narceia meconine, thebaina, meconic acid, brown acid extractive, sulphuric acid, resin, fat oil, gummy matter, caoutchouc, albumen, odorous principle,* and *lignin.* It is probable that several of these substances are the products of the processes employed for obtaining them, and that they do not all preexist in the opium. The two most important constituents are morphia and meconic acid, which exist in combination as meconate of morphia. *Morphia* presents itself in the form of transparent crystals; it has an alkaline re-action; it is nearly insoluble in water, but soluble in alcohol, oils, alkalies, and acids, with the last forming salts. Morphia has the following characteristics:—Nitric acid reddens it; iodic acid is deoxidized by it, iodine being set free, when it gives a blue colour with starch; sesquichloride of iron renders the crystals blue; infusion of galls gives a precipitate (tannate of morphia) in neutral solutions of the salts of morphia. Morphia and its salts have a bitter taste. *Meconic acid,* when pure, is in the form of white micaceous scales, soluble in four times their weight of boiling water. It reddens the sesqui-salts of iron, forming the meconate of the sesquioxide of iron, and gives white precipitates (meconates), which are soluble in nitric acid, with acetate of lead, nitrate of silver, and chloride of barium. Of the constituents of opium those which are said to be poisonous are, *morphia, codeia,* and *thebaina;* the rest are almost or altogether inert. *The purity and strength of opium* are best estimated by extracting and ascertaining the amount of morphia which it contains. Good opium ordinarily contains about eight per cent. of morphia. Effects.—In small doses, as from a quarter of a grain to one grain, opium usually acts as a stimulant; the pulse is increased in frequency, the mind is exhilarated, ideas flow

more quickly, a pleasurable state of the system is induced, and there is a capability of greater exertion. These symptoms are followed by a diminution of muscular power and a desire of repose, with a tendency to sleep. In a *full medicinal dose*, the stage of excitement is soon followed by that of depression, and there is an irresistible desire to sleep. After waking there is often some nausea, furred tongue, headache, and listlessness. *Effects of a poisonous dose.*—The symptoms of poisoning with opium, when it is administered at once in a dangerous dose, begin with giddiness and stupor, generally without any previous stimulus: the stupor rapidly increasing, the person becomes motionless and insensible to external impressions; he breathes very slowly, generally lies quite still, with the eyes shut, and the pupils contracted, and the whole expression of the countenance is that of deep and perfect repose. As the poisoning advances the features become ghastly, the pulse feeble and imperceptible, the muscles exceedingly relaxed, and, unless assistance is speedily procured, death ensues. If the person recovers, the stupor is succeeded by prolonged sleep, which commonly ends in twenty-four or thirty-six hours, and is followed by nausea, vomiting, giddiness, and loathing of food. The *habitual use of opium*, either for chewing or smoking, is said to have a most injurious effect upon the health; but there appears some reason to doubt the accuracy of the statements which have been made on this point. The only constant effect of opium-eating is constipation. *Effect of opium on the different organs.*—1. *On the Nervous System.* It diminishes sensibility, allays pain and spasm, or convulsive movements of the muscles, and promotes sleep. 2. *On the Digestive System.* It diminishes secretion, producing dryness of the mouth, thirst, retarding the digestive process, and producing constipation. 3. *On the Vascular System.* Its effect is not uniform; it generally acts first as an excitant, and subsequently as a sedative. 4. *On the Respiratory System.* It checks the secretion of the bronchial mucous membrane, and retards expectoration; at the same time it appears to interfere with the arterialization of the blood. 5. *On the Cutaneous System.* It increases the secretion by a stimulating effect. The above is a very general statement of the influence of opium on the most important sets of organs. Uses.—The uses of opium may be in a great measure inferred from a knowledge of its physiological effects. We can only very briefly mention the most important diseases in which this very valuable medicine is employed. In fevers it is used to relieve watchfulness and restlessness, delirium, tremor, and diarrhœa. In inflammations it is used to relieve pain, to act as a sedative, and to promote the action of mercury. In diseases of the brain and spinal cord;—thus, in delirium tremens to procure sleep, and in tetanus to remove convulsions. In some diseases of the chest it is used to allay cough and irritation, but its use in these cases requires great caution. In some diseases of the urinary organs it is used to allay pain and irritation. It is used in mortification, in venereal diseases, in rheumatism, and in a multitude of cases which it would be tedious and useless to mention. There is, perhaps, no one remedy so valuable and so extensively used as opium. Dose.—Opium may be given in substance in doses of from gr. $\frac{1}{2}$. to grs. iij., according to the effect which we wish to produce, and the nature of the disease in which it is administered. Thus, a patient with tetanus will take an almost incredible quantity of opium without appearing to be in any way affected by it. The *tincture* of the Pharmacopœia contains one grain of opium in ♏xix.

The salt of morphia which is most commonly used is the hydrochlorate. The directions for its preparation are long and somewhat complex. In a few words, it consists essentially in this:—Macerate opium in water; the result is a solution of meconate of morphia; add to this a solution of chloride of lead; we thus obtain an insoluble precipitate of meconate of lead and a solution of hydrochlorate of morphia. This is purified by digesting with animal charcoal, and is obtained in a crystalline state by evaporation. In comparing the action of morphia and its salts with that of opium, the former are observed to be less stimulant and less disposed to cause headache, sweating, constipation, and dryness of the tongue; the stimulant effect of morphia too is less than that of opium. The dose of the salts of morphia is from gr. $\frac{1}{8}$. to gr. $\frac{1}{2}$. Antidotes.—In a case of poisoning by opium, the first indication is to remove the poison from the stomach; this may be done by the stomach-pump, if at hand, or by emetics of sulphate of zinc or copper, mustard or salt, or by tickling the throat with a feather. Having removed the poison from the stomach, we must endeavour to counteract the injurious effects of any portion of it which may have become absorbed. The patient must be roused by every means calculated to have such an effect,—by walking him about between two men, by cold affusion, by irritants, such as blisters or sinapisms, taking care that the latter be not allowed to remain on sufficiently long to produce sloughing. There is one proceeding which will often rouse the patient when all others have failed; it consists in allowing the patient to lie on the bed, removing the shoes and stockings, and flicking the soles of the feet with a towel, the corner of which has been dipped in cold water. Stimulants must be administered, such as ammonia and coffee, and, in extreme cases, artificial respiration and electricity to the chest must be resorted to.

Phosphorus. Preparation.—It is obtained from bone-ash, by digesting it in sulphuric acid, by which sulphate and superphosphate of lime are procured; the first precipitates while the latter remains in solution. The solution is to be evaporated nearly to dryness, then mixed with charcoal, and distilled in an earthen retort; the charcoal abstracts the oxygen from the phosphoric acid of the superphosphate, setting free the phosphorus, which is volatilized. Properties.—It is a pale yellow, semi-transparent, highly combustible solid. It is insoluble in water, but soluble in ether and oils. Effects and Uses.—In small doses it is a powerful diffusible stimulant, and in large doses it is an irritant poison. It is seldom given internally. Antidote.—In a case of poisoning by phosphorus we must give oil or some other liquid which may envelope it and prevent its oxidation, as it is by attracting oxygen and thus becoming converted into an acid that phosphorus acts as a caustic when swallowed. At the same time magnesia should be given to neutralize any acid which may be formed.

Physeter Macrocephalus—*The Spermaceti Whale.*—*Cl. Mammalia. Ord. Cetacea.* Hab.—Pacific Ocean, Indian and Chinese Seas. Extraction of Spermaceti.—In the right side of the nose and upper surface of the head of the whale is a triangular cavity;

into this the whalers make an opening, and take out the contents (oil and spermaceti) by a bucket. In cold weather the spermaceti is a congealed solid, and it is separated from the oil, with which it was combined in the cavity of the head, by filtering. Effects and Uses.—Spermaceti is emollient and demulcent; it is seldom given internally, its chief medicinal use being for the preparation of ointments and cerates.

Pinus—*The Pine.*—*Sex. syst. Monœcia. Monadelphia. Nat. ord. Coniferæ.*—Several species of *Pinus*, also some species of *Abies* and *Larix*, yield the various medicinal substances obtained from the coniferous family. *Turpentine* is obtained by making incisions into the trees; the turpentine exudes, and is collected and placed in casks. Composition.—There are several varieties of turpentine, but they have all the same general composition. The most abundant constituents are *volatile oil* and *resin*. Effects and Uses.—Turpentine is a stimulating expectorant, diuretic, and diaphoretic. In large doses it produces vomiting and purging. It is used in chronic discharges from the urinary organs, in chronic catarrh, and in chronic rheumatism. It is sometimes used as a local application to indolent ulcers. Dose, ℈j. to ʒj.

Oil of Turpentine is obtained by submitting to distillation a mixture of turpentine and water; the oil distils over with the water and floats on its surface. Properties.—It is a colourless, limpid, inflammable liquid, having a peculiar odour and a hot taste. It is composed of carbon and hydrogen. Effects and Uses.—In small doses its action is the same as that of turpentime, and in full doses it produces a feeling of intoxication, and subsequently acts as a smart purgative; in some cases it produces excessive irritation of the urinary organs, and this effect is more likely to occur when it does not pass off freely by the bowels. Oil of turpentine is a valuable remedy against the tapeworm; it is also used in chronic discharges from the mucous membranes, in puerperal fever, in rheumatism, and in some other cases which we need not particularly mention. Dose.—As a diuretic, ♏x. to f. ʒj.; as a general stimulant, ʒj. or ʒij.; and as an anthelmintic, f. ℥ ſs. to f. ℥ ij. *Resin* is the residue of the process for obtaining oil of turpentine; its chief use is in the formation of plaster and ointments, which it renders very adhesive, and slightly stimulant.

Piper Nigrum—*The Black Pepper.*—*Sex. syst. Diandria. Trigynia. Nat. ord. Piperaceæ.* Hab.—East and West Indies. Parts used.—The berries. Composition.—*Resin, volatile oil, and piperin.* Effects and Uses.—Pepper is an acrid stimulant and diaphoretic; it is sometimes used in ague, and it has a beneficial effect in some diseases of the rectum. Dose.—from grs. v. to grs. xv. In the Pharmacopœia there is a *confection of black pepper*, which is often very useful in piles.

Piper Longum—*The Long Pepper.* Hab.—India. Composition, Effects, and Uses.—Analogous to those of black pepper.

Piper Cubeba—*The Cubeb Pepper.* Hab.—Java. Parts used.—The dried, unripe fruit. Composition.—Analogous to that of black pepper. Effects and Uses.—Cubebs are acrid stimulants; they exercise a specific influence over the urino-genital organs. Their chief use is in gonorrhœa; they may be given with safety in the early stage of the disease, and they sometimes arrest it at once. Dose, grs. x. to ʒij.

Pistacia Terebinthus—*The Turpentine Pistacia.*—*Sex. syst. Diœcia. Pentandria. Nat. ord. Terebinthaceæ.* Hab.—Syria and the Grecian Archipelago. Part used.—The turpentine, which is extracted by making incisions into the trunk of the tree. It is called Chian or Cyprus turpentine. Composition, Effects, and Uses.—Similar to those of the coniferous turpentines.

Plumbum—*Lead.* Preparation.—Metallic lead is usually extracted from galena (native sulphuret of lead). The galena is roasted, by which it is converted into a mixture of sulphate and oxide of lead, and afterwards smelted with coal and lime, the first to abstract oxygen, the second to remove the sulphur. Characteristics.—If lead be dissolved in nitric acid we may recognize its presence by the following tests:—Alkalies and their carbonates, and sulphuric acid and the sulphates, give white precipitates; iodide of potassium gives a yellow precipitate, and sulphuretted hydrogen a black one; a piece of zinc placed in the solution throws down metallic lead in the arborescent form. Effects.—Metallic lead is probably inert. The *salts of lead*, in small doses, act on the alimentary canal as astringents; when absorbed they act as general astringents, checking hæmorrhages and the secretions of the skin and mucous membrane. The long-continued use of the preparations of lead is followed by the most disastrous effects upon the muscular and nervous systems. One of these consequences is lead colic, another palsy of the extensor muscles of the fore arm, called *wrist-drop;* in extreme cases all the muscles waste and become exceedingly weak. In some cases epileptic fits occur, and even apoplexy. After death in these cases, lead can be detected in all the tissues, abundantly in the brain and muscles. Workmen in lead often present all the above-mentioned symptoms. The same consequences sometimes result from living in freshly-painted rooms, or from drinking water which has been kept in leaden vessels. It is remarkable that the water which is most free from alkaline and earthy salts is most likely to act upon and dissolve lead. If we examine the mouth of any person whose system is contaminated with lead, we meet with evidence of the fact in the presence of a blue line at the margin of the gum surrounding each tooth. Uses.—The preparations of lead are given internally to check hæmorrhage, and excessive secretion, and exhalation. They are sometimes applied locally to subdue inflammation.

Plumbi Acetas—*Acetate of Lead.* Preparation.—By dissolving oxide of lead in acetic acid; this is commonly called *sugar of lead.* It has a sweetish astringent taste, and is soluble in both water and alcohol. Characters.—It is known to be the acetate by the vapour of acetic acid, which it gives off when heated with sulphuric acid. Composition.—One eq. oxide of lead, one eq. acetic acid. Effects and Uses.—Those of the compounds of lead generally. This is the salt which is most commonly employed; in large doses it acts as a slightly irritant poison. Dose, gr. j. or gr. ij. Much more may be given in a dose. Its use should not be long continued. Antidotes.—Solutions of the sulphate of potash, soda, or magnesia.

Plumbi Diacetatis Liquor—*Solution of the Diacetate of Lead.* Preparation.—By boiling acetate of lead with the oxide of lead. It is a transparent colourless liquid, and contains in solution a salt of lead, composed

of 2 eqs. oxide of lead, and 1 eq. acetic acid. Uses.—It is used, when diluted, forming *Goulard water*, as a local application to inflamed surfaces. It is a constituent of the *Ceratum Plumbi Compositum.*

Polygala Senega—*Sex. syst. Diadelphia. Octandria. Nat. ord. Polygaleæ.* Hab.—United States of America. Parts used.—The roots. The taste of the root is at first sweetish, afterwards acrid and pungent. Composition.—The active principle is *polygalic acid.* Effects and Uses.—In small doses it is a stimulating diaphoretic, diuretic, and expectorant; in large doses emetic and purgative. Its chief use is in the latter stages of acute, and in chronic bronchitis. Dose.—Of the powder, grs. x. to ℈ j. It is best given in the form of *decoction.*

Potassa.—*Potash.*

Potassæ Liquor—*Solution of Potash.* Preparation.—Add fresh burnt lime to a solution of the carbonate of potash; when cold the supernatant liquor is to be poured off; this is the liquor potassæ; the carbonate of lime is precipitated. Properties.—It is a limpid, colourless, transparent liquid, having an acrid caustic taste: it corrodes flint glass, and must be kept in green glass bottles. Characteristics.—Potash, free or combined, has the following characters:—It gives no precipitate with the hydro-sulphurets, ferrocyanides, or carbonates; tartaric acid in excess gives a precipitate of the bitartrate; chloride of platinum gives a yellow precipitate; the salts of potash give a violet tinge to the flame of alcohol. Effects.—The local action of solution of potash is that of a caustic; it forms soluble compounds with albumen and fibrin. Internally, in small doses, diluted, it neutralizes the free acids of the stomach; hence the continued use of alkalies impairs the digestive powers. If the quantity taken be more than sufficient to neutralize the free acids of the stomach, it becomes absorbed and acts on the urine, rendering it alkaline, and favouring the deposit of the phosphates; it also increases the quantity of the urine. The continued use of alkalies is said to increase the activity of the absorbents, and, after a time, to produce a condition of the system analogous to scurvy. In large doses liquor potassæ acts as an irritant poison, corroding the stomach, and frequently producing perforation. Uses.—Liquor potassæ is used as an antacid in dyspepsia, to alter the quality of the urine in the lithic acid diathesis, to remove induration and enlargement of the glands, and in syphilis and scrofula. Dose.—from ♏x. to ♏xxx. Antidotes.—Acids or oils.

Potassæ Hydras—*Hydrate of Potash*—prepared by evaporating the liquor potassæ to dryness; the residual mass is then fused and poured into moulds. Composition.—One eq. potassæ, one eq. water. Effects and Uses.—It is an exceedingly energetic caustic, and is used for making issues, and for the other purposes for which caustics are required. The use of it requires caution, as it is apt to spread further than is intended.

Potassæ Carbonas—*Carbonate of Potash.* Preparation.—It is obtained either by lixiviating wood-ashes, or by heating bisulphate of potash in a furnace with charcoal. In the latter process the oxygen of the sulphuric acid is abstracted by the carbon, and sulphuret of potassium remains; by further heating, the potassium combines with oxygen from the air, and with carbonic acid from the combustion of the charcoal, and thus we obtain carbonate of potash. Composition.—One eq. carbonic acid, one eq. potash. Effects and Uses.—The effects of carbonate of potash are of the same kind as those of the liquor potassæ, but less in degree; it is used in the same cases. It is sometimes used for making the effervescing draught, with citric or tartaric acid. Dose.—grs. x. to ʒ ſs. Antidote.—Acids or oils.

Potassæ Bicarbonas—prepared by passing carbonic acid gas through a solution of the carbonate of potash. It contains one eq. carbonic acid more than the carbonate. Effects and Uses.—Similar to those of the carbonate; its local action is less. It is often used in making the effervescing draught. The proportions are 20 grains of the bicarbonate to 14 grains of citric acid, 15 grains of tartaric acid, ʒ iij. ſs, of lemon-juice. Dose, grs. x. to ʒ ſs.

Potassæ Bitartras—*Cream of Tartar.*—It is obtained from the interior of wine casks, where it is deposited during the fermentation of the grape-juice in which it was dissolved. Properties.—This salt forms a white crystalline mass, having an acid gritty taste. It is very slightly soluble in water. Effects and Uses.—In small doses it is a refrigerant and diuretic, and in larger doses purgative. It is used for making refrigerant drinks in febrile and inflammatory diseases, as a diuretic in dropsy, and as a purgative combined with jalap or some other purgative.

Potassæ Nitras—*Nitrate of Potash.* Preparation.—The nitre consumed in this country is imported from India. It there developes itself on the surface of the soil in the form of a thin white efflorescence, resembling frost-rind. It is collected and purified by solution, filtration, and crystallization. It may also be formed artificially. Composition.—One eq. nitric acid, one eq. potash. Effects and Uses.—In small doses nitre is diuretic and refrigerant; in large quantities it acts as an irritant poison. It is much used in febrile and inflammatory diseases, combined with other saline medicines. Dose, grs. x. to ʒ ſs.

Potassii Iodidum—*Iodide of Potassium.* Preparation.—An iodide of iron is first formed by heating iodine with iron filings in water; a solution of carbonate of potash is then added, carbonate of iron precipitates, and iodide of potassium remains in solution. The liquor is poured off, and, by evaporation, crystals of iodide of potassium are obtained. Properties.—This salt occurs on white shining cubes or octahedrons: it is soluble in both water and alcohol. Composition.—One eq. iodine, one eq. potassium. Effects and Uses.—The effects and uses are similar to those of iodine. It is a most valuable remedy in some forms of secondary syphilis, especially when the periosteum is affected. It is frequently given in combination with iodine. Dose, usually about grs. iij.

Potassii Bromidum—prepared in the same way as the iodide. It has been used with great success in cases of enlarged spleen. Some other salts of potash are occasionally used. We can do no more than enumerate them: *P. Sulphas, P. Bisulphas, P. Tartras, P. Acetas, P. Sulphuretum, P. Ferrocyanidum, P. Chloras.*

Potentilla Tormentilla—*The Tormentil.*—*Sex. syst. Icosandria. Polygynia. Nat. ord. Rosaceæ.* Hab.—Indigenous. Part used.—The root. Composition.—It contains *tannin* in considerable quantities. Effects and Uses.—It is tonic and astringent. Used in chronic diarrhœa and passive hæmorrhages. Dose,

ʒ ss. to ʒ j. The best form for administering it is the *decoction*.

Pterocarpus Erinaceus—*The Hedgehog Pterocarpus.—Sex. syst. Diadelphia. Decandria. Nat. ord. Leguminosæ.* Hab.—Woods of the Gambia; Senegal. When an incision is made into the bark of this tree, a juice exudes and concretes. It is at first pale, but by exposure to the air it assumes a deep red hue. Two substances are met with in commerce under the name of kino; one is the inspissated juice of eucalyptus resinifera, the other is imported from India; the tree which yields it is not known; probably it is not the pterocarpus. Composition.—Kino contains a large proportion of *tannin*, with some *gum*. Effects and Uses.—It is tonic and astringent in diarrhœa, leucorrhœa, &c. Dose, grs. x. to ʒ ss. The tincture is sometimes used.

Punica Granatum—*The Pomegranate.—Sex. syst. Icosandria. Monogynia. Nat. ord. Granateæ.* Hab.—Northern Africa. Introduced into Europe. Parts used.—The rind of the fruit and the bark of the root. Composition.—Both these parts contain *tannin* and *resin*. Effects and Uses.—Astringent; the bark of the root in the form of decoction is used as a remedy against tape-worm. The rind of the fruit may be given as an astringent and tonic.

Quassia or Picræna Excelsa—*The Quassia Tree.—Sex. syst. Decandria. Monogynia. Nat. ord. Simarubiaceæ.* Hab.—Jamaica. Part used.—The wood, which is white and has an extremely bitter taste. Composition.—It contains a bitter principle, *quassite*. Effects and Uses.—It is a simple bitter tonic, and is usefully given in dyspepsia, and in the convalescence from acute diseases. It is usually given in the form of *infusion*.

Quercus Pedunculata—*The Common British Oak. Sex. syst. Monœcia. Polyandria. Nat. ord. Cupuliferæ.* Hab.—Indigenous. Part used.—The bark. Composition.—It contains large quantities of tannic and gallic acid. Effects and Uses.—Oak bark is a powerful astringent and tonic. It may be used as a gargle in relaxed sore throat, as an astringent wash or injection, or it may be taken internally in diarrhœa and dysentery. Dose, in powder, ʒ ss. to ʒ ij. The *decoction* is the best form.

Quercus Infectoria—*The Gall* or *Dyer's Oak.*—Hab.—Asia Minor. Part used.—The nut-galls. An insect pierces the bark of the shoots, and deposits its egg in the wound. The irritation thus produced gives rise to an influx of juices to the wounded part, and an excrescence forms which is called a gall. Composition.—The chief constituents are tannic and gallic acid. Effects and Uses.—Galls are powerful astringents, and as such are used in hæmorrhages and in chronic mucous discharges. Galls may be used as an antidote in poisoning by those vegetables whose activity depends on an alkali, as opium, nux vomica, &c., with which the tannic acid in the galls forms an insoluble salt. Galls may be used as a local astringent. Dose, grs. x. to grs. xx.

Quinia.—Vide *Cinchona*.

Rheum—*The Rhubarb.—Sex. syst. Enneandria. Monogynia. Nat. ord. Polygonaceæ.*—It is not yet ascertained what species of *Rheum* yields the officinal rhubarb. Several kinds of rhubarb are found in commerce, viz.: *Russian*, *Dutch-trimmed*, *Chinese*, *Himalayan*, *English*, and *French*. Composition.—Rhubarb contains *odorous* and *colouring matter*, *tannin*, *bitter principle*, *rhaponticin*, *oxalate of lime*. Effects and Uses.—In small doses rhubarb acts as an astringent tonic. In larger doses it operates slowly and mildly as a purgative; its purgative action is followed by an astringent effect. It is a useful purgative for children. It is given in some cases of diarrhœa, and as a stomachic and tonic in dyspepsia. Dose, as a purgative, from ℈ j. to ʒ j. In the Pharmacopœia there is an *infusion*, *a compound tincture*, and an *extract*.

Ricinus Communis—*The Castor Oil Plant.—Sex. syst. Monœcia. Monadelphia. Nat. ord. Euphorbiaceæ.* Hab.—East and West Indies. Part used.—The oil expressed from the seeds. The best oil is that which is obtained without the aid of heat. Effects and Uses.—It is a mild but certain purgative, acting very quickly, and seldom griping. It may be given in all cases where an unirritating purgative is required. Dose, f. ℥ ss. or ℥ j.

Rosa Canina—*The Dog Rose.—Sex. syst. Icosandria. Polygynia. Nat. ord. Rosaceæ.* Hab.—Indigenous. Part used.—The pulp of the *hip*. Effects and Uses.—It is slightly refrigerant and astringent. It is used for making the *Confectio Rosæ Caninæ*, which is an agreeable vehicle for other remedies.

Rosa Gallica—*The French or Red Rose.* Hab.—South of Europe. Parts used.—The petals. Effects and Uses.—Slightly astringent and tonic. Chiefly used for their colour and flavour.

Rosa Centifolia—*The Hundred-Leaved or Cabbage Rose.* Hab.—Asia. Cultivated at Mitcham. Parts used.—The petals. Effects and Uses.—The petals are mildly laxative, and are employed on this account in the form of syrup. They are also used for their odour in the distillation of rose-water.

Ruta Graveolens—*The Common Rue.—Sex. syst. Decandria. Monogynia. Nat. ord. Rutaceæ.* Hab.—South of Europe. Cultivated in gardens. Part used.—The herb. Composition.—It contains *volatile oil* and *bitter extractive*. Effects and Uses.—Rue is a stimulant antispasmodic, and is supposed to be emmenagogue. It is very efficacious in the flatulent colic of children. It is best given in the form of *infusion*.

Sabina.—Vide *Juniperus*.

Sagapenum.—Vide *Ferula*.

Sapo—*Soap*.—Soap is a compound of margaric and oleic acids, with an alkaline, or an earthy, or an oxidized metallic base. The first kind is used in medicine. There are two kinds of alkaline soap; one made with soda, and called *hard soap;* the other made with potassa, and called *soft soap*. Effects and Uses.—Soap is purgative. It is seldom given alone, but it is a constituent of many of the pills ordered in the Pharmacopœia.

Sarsaparilla.—Vide *Smilax*.

Sassafras Officinale—*The Sassafras Tree.—Sex. syst. Enneandria. Monogynia. Nat. ord. Lauraceæ.* Hab.—North America. Part used.—The wood. Effects and Uses.—A stimulant, sudorific, and alterative, in rheumatic and venereal diseases. It is a constituent of the *Decoctum Sarzæ Compositum*.

Scammonia.—Vide *Convolvulus*.

Scilla Maritima—*The Squill.—Sex. syst. Hexandria. Monogynia. Nat. ord. Liliaceæ.* Hab.—Shores of the Mediterranean. Parts used.—The bulbs. Two kinds of squills are met with, *white* and *red*, from the colour of their scales. Composition.—*An acrid matter*, and *scillitin*. Effects and Uses.—In small doses a

stimulating expectorant and diuretic; in large doses, emetic and purgative. In excessive doses it is an acrid poison. It is used as a diuretic in dropsies, and as an expectorant in chronic pulmonary affections. Dose, of the powder as an expectorant or diuretic, gr. j. The following preparations are used:—*Tinctura*, *Acetum*, and *Oxymel Scillæ*.

Senna.—Vide *Cassia*.

Simaruba Officinalis—*Mountain Damson.*—*Sex. syst. Decandria. Monogynia. Nat. ord. Simarubaceæ.* Hab.—West Indies. Part used.—The bark of the root. Effects and Uses.—In small doses it is a bitter tonic; in large ones, emetic and purgative. It has been chiefly used in dysentery. It may be given in the form of *infusion*.

Sinapis Nigra—*The Black Mustard.*—*Sex. syst. Tetradynamia. Siliquosa. Nat. ord. Cruciferæ.* Hab.—Indigenous. Part used.—The seed. Effects and Uses.—Mustard is an acrid stimulant: applied to the skin it produces rubefaction, vesication, and ulceration, if allowed to remain sufficiently long. Internally, in moderate doses, it is a stimulant, promoting the appetite and digestion: in larger doses it is emetic. It may be used as an emetic in cases of narcotic poisoning. The mustard cataplasm is applied to the skin as a counter-irritant, or to rouse the system in affections of the brain. As an emetic, the dose is from a tea-spoonful to a table-spoonful of the flour in water.

Sinapis Alba—*White Mustard.* Effects and Uses.—Similar to those of the black. It is less acrid than the black.

Smilax—*Several species yielding Sarsaparilla.*—*Sex. syst. Diœcia. Hexandria. Nat. ord. Smilaceæ.* Hab.—South America. Parts used.—The roots. Composition.—*Volatile oil*, *smilacin*, *starch*, *resin*, and *extractive.* Effects and Uses.—Sarsaparilla is diuretic, diaphoretic, nutritive, and an alterative tonic. It is given in some forms of syphilis, rheumatism, and cutaneous diseases. It is usually given in the form of *decoction*, either simple or compound; there is also a syrup and an extract.

Sodæ Carbonas—*Carbonate of Soda.* Preparation.—It is obtained from the ashes of sea-side plants, and from sulphate of soda in the same manner as carbonate of potash is obtained from the sulphate. Characteristics.—It is distinguished from the salts of potash by not giving a precipitate with tartaric acid, or with chloride of platinum, and by the yellow tinge which it communicates to the flame of alcohol. Effects and Uses.—The same as those of carbonate of potash.

Sodæ Bicarbonas—prepared in the same manner as the bicarbonate of potash, and used in the same cases.

Sodii Chloridum—*Chloride of Sodium* (*common salt*)—prepared by evaporating the water of brine springs. Effects and Uses.—This salt probably serves some important purposes in the economy; it always exists in the blood. In small doses it seems to act as a tonic and alterative; in larger doses it is an emetic and purgative. It is not much used as a medicine, but is sometimes given as an emetic in doses of two or three table-spoonfuls. It forms an useful enema; and a solution in water is sometimes used as a bath.

Sodæ Chlorinatæ Liquor—prepared by passing chlorine into a solution of carbonate of soda. Effects and Uses.—The same as those of calcis hypochloris. Dose.—♏xx. or more.

Sodæ Biboras—*Borax.*—This salt is used as a detergent in the form of gargle, or of the *Mel Boracis* in cases of aphthæ and ulceration of the mouth in infants.

Sodæ Sulphas—This is a purgative salt, in doses of ℥ fs. to ℥ j.

Sodæ Potassio-Tartras.—This is a double tartrate of soda and potash. It is a mild laxative in doses of ℥ fs. to ℥ j.

Sodæ Acetas is diuretic in doses of from ℈ j. to ʒ ij. Its chief use is in the preparation of acetic acid.

Solanum Dulcamara—*Woody Nightshade.*—*Sex. syst. Pentandria. Monogynia. Nat. ord. Solanaceæ.* Hab.—Indigenous. Part used.—The stems. Effects and Uses.—It is slightly diuretic and diaphoretic. In large doses it is said to be an acro-narcotic poison. It is thought to be useful in some chronic skin diseases. It is given in the form of decoction.

Spigelia Marilandica—*The Indian Pink*—*Sex. syst. Pentandria. Monogynia. Nat. ord. Spigeliaceæ.* Hab.—North America. Parts used.—The root. Effects and Uses.—In moderate doses it is vermifuge without producing any sensible effect on the system, in large doses it is an acro-narcotic poison. It is used only as a vermifuge. Dose.—For an adult ʒ j. to ʒ iij. of the powdered root.

Spiritus Rectificatus—Sp. gr. 838. It is used as a pharmaceutical agent.

Spiritus Tenuior—*Proof Spirits.*—Sp. gr. 920. It is a powerful diffusible stimulant. It is chiefly used for preparing *tinctures* and the *spirits* of the Pharmacopœia.

Spiritus Vini Gallici—*Brandy.*

Spiritus Ætheris Nitrici—prepared by adding nitric acid to rectified spirit, and distilling. It is a compound of ether and hyponitrous acid. Effects and Uses.—It is refrigerant, diuretic, and diaphoretic; used in dropsies and in febrile and inflammatory diseases. Dose f. ʒ fs. or f. ʒ j.

Stannum—*Tin.*—Tin filings are sometimes used as an anthelmintic: their *modus operandi* is not well known, but they are generally supposed to act mechanically. An ounce of powdered tin may be given in treacle.

Strychnos, Nux Vomica—*The Poison Nut.*—*Sex. syst. Pentandria. Monogynia. Nat. ord. Apocynaceæ.* Hab.—India, Ceylon. Parts used.—The seeds. They are round, peltate, concave on one side, convex on the other. The testa is covered by short silky hairs. Composition.—The seeds and the bark contain two alkalies, *strychnia* and *brucia*, which have an intensely bitter taste. Effects.—In small doses nux vomica is tonic and diuretic. In large doses it produces convulsions and rigidity of all the muscles; in excessive doses, a condition like tetanus is induced, and the animal dies from asphyxia. The effect of nux vomica, and of its alkalies is directly the reverse of that of *conia.* Uses.—Nux vomica and strychnia have been used with success in some cases of palsy, in amaurosis, and in some other affections of the nervous system. Its use should not be long continued, as it is apt to accumulate and suddenly produce violent symptoms. Dose.—Of powdered nux vomica, grs. ij. of strychnia, gr. $\frac{1}{16}$.

Styrax Officinale—*The Storax.*—*Sex. syst. Decandria. Monogynia. Nat. ord. Styraceæ.* Hab.—The Levant. Storax exudes from incisions made into the stem of the tree. Composition.—*Volatile oil*, *resin*, *benzoic acid.* Effects and Uses.—It is a stimulating expectorant, and is chiefly used in chronic bronchial affections. Dose, grs. v. to grs. x.

Styrax Benzoin.—*The Benjamin Tree.* Hab.—Sumatra, Borneo, Java, Siam. It is obtained in the same manner as storax. Its composition, effects, and uses are also analogous. Dose, grs. x. to ʒ fs. It is seldom given alone: in the Pharmacopœia there is a preparation called *Tinctura Benzoini Composita.*

Sulphur is found native in the neighbourhood of volcanoes, and is purified by distillation. Effects and Uses.—It is laxative and a stimulating diaphoretic. As a laxative it is used in cases of piles, and as a diaphoretic in some chronic cutaneous diseases. It is a specific for the itch, applied in the form of ointment. Dose, ℈ j. to ʒ ij. in treacle.

Tamarindus Indica—*The Tamarind*—is used for its pulp, which is refrigerant and laxative. It is seldom gi en alone, but is one of the constituents of the *confectio sennæ.*

Valeriana Officinalis—*The Valerian.—Sex. syst. Triandria. Monogyia. Nat. ord. Valerianaceæ.* Hab.—Indigenous. Parts used.—The root. Composition.—*Volatile oil*, a *volatile acid*, and *resin.* Effects and Uses.—It is stimulant and antispasmodic. It may be given in hysteria. Dose, ℈ j. to ʒ j.

Veratrum Album—*The White Hellebore.—Sex. syst. Polygamia. Monœcia. Nat. ord. Melanthaceæ.* Hab.—Mountainous regions of Europe. Part used.—The rhizome. Composition.—It owes its activity to *veratria.* Effects.—It is a violent cathartic, emetic, and sternutatory: in large doses it produces bloody stools, sinking of the pulse, tremblings, convulsions, and death. Uses.—It has been used in some affections of the nervous system, in chronic skin diseases, and in gout. Dose, gr. j. In the Pharmacopœia, there is a *vinum veratri.* There is also a *decoction* and an *ointment* for local application.

Zinci Sulphas—*Sulphate of Zinc*—prepared by dissolving zinc in dilute sulphuric acid, and evaporating to dryness. Composition.—1 eq. sulphuric acid, 1 eq. oxide of zinc. Effects and Uses.—In small doses it is astringent, tonic, and antispasmodic. In full doses it is a safe and quickly acting emetic: in excessive doses it is an irritant poison. As an emetic it is used in cases of narcotic poisoning: as an astringent in diarrhœa and in chronic discharges from the urinary and bronchial mucous membrane; as a tonic and antispasmodic, it is used in chorea and epilepsy. As a local astringent, it is used in the form of collyrium in ophthalmia, and of an injection in gonorrhœa. Dose.—As an emetic, ℈ j.; to produce its other effects, from gr. i to gr. v.

Zinci Oxydum—*Oxide of Zinc.*—This is used chiefly as a desiccating local application in the form of powder dusted on the part, or in the form of ointment.

Zinci Carbonas.—The impure carbonate of zinc is called calamine. Its uses are the same as those of the oxide. *Ceratum Calaminæ* is an useful desiccating application.

ELEMENTARY PRINCIPLES OF MEDICINE.

THE premature death which awaits so large a portion of the human race is in a great measure owing to disease; and Medicine is that science which determines the existence and nature, as well as the means of preventing and of curing this class of physical evils.

The causes of disease are of two descriptions, or general and specific. The *general* causes are mechanical or chemical injuries, atmospheric vicissitudes, errors in diet, and powerful moral impressions; and, out of a total of 338,979 deaths in England and Wales, in 1841, the number of persons who died from these causes was 273,636. The *specific* causes are morbid poisons, as that of small-pox, of typhus fever, of measles, of scarlatina, or other contagion; and the number of deaths which resulted from these causes, in 1841, in England and Wales, amounted to 65,343. As the diseases arising from these two different classes of causes are entirely opposed, both in their laws and treatment, it is intended to form them into two great divisions, or into diseases arising from general causes and into diseases arising from specific causes, and to make these the basis of the arrangement of the present treatise. The diseases arising from general causes, being far greater in number and much less complex in their phenomena than those depending on morbid poisons, are entitled to be first considered.

OF THE DISEASES ARISING FROM GENERAL CAUSES.

The number of diseases arising from the action of general causes appears to be immense; but, on a careful analysis, they resolve themselves into two great orders, or into diseases of function, and into diseases of structure (*morbi organici et simplices*), each embracing a small number of classes. The diseases of function, for instance, embrace the neuroses, hæmorrhages, and dropsies; while inflammation, tubercle, cancer, melanosis, hypertrophy, and atrophy, are the subordinate classes of the diseases of structure. It is proposed to treat of the various species of disease comprised in each class under the head of the particular class to which they belong, prefacing each order and each class with a short outline of its most general laws.

OF THE DISEASES OF FUNCTION.

The diseases of function embrace all those diseases in which the action, the secretion, or the sensation of a part is impaired, without any primary alteration of structure of the organ or tissue affected. Thus, mania, catalepsy, neuralgia, anæsthesia, and palsy, are neuroses of the brain or other portion of the nervous system. Colic, vomiting, diarrhœa, and constipation, are neuroses of the alimentary canal; and so on of other parts. Hæmorrhage, or the effusion of blood, and dropsies, or an effusion of water into the shut cavities of the body, as that of the head, chest, or abdomen, are other instances of functional disease. These two latter classes, however, are so extremely well marked in their phenomena, in whatever part of the body they may occur, that they seem to form each a distinct family; and, consequently, it appears more proper to treat each of them under a separate head.

No science can be understood without some reference to its elementary principles; and three systems have prevailed at different times to explain disease, or vitalism, solidism and humoralism. It seems probable, however, we must adopt the essential parts of all three systems in a sound philosophy of Medicine. Vitalism, for instance, supposes that a morbid state of the vital principle is the cause of disease. This may be questionable; but it is certain that this great principle differs, or has a different force, in childhood, in manhood, and in old age; and also that this force varies, not only at different periods of life, but in different seasons, and even in the same day and in the same hour, in the same person. Disease, therefore, can hardly be understood without taking this element into consideration; and the different phases and force of the vital principle, and the different modifications impressed upon it by social position, necessarily form the most leading feature in what are termed the *predisposing causes*, or the different degrees of liability of persons of different sex, age, profession, or habits, to fall into a given disease.

Besides a given state of the vital principle, a healthy condition of the solids and fluids (the *excitor* and *excited* forces of the body) is equally essential to health. Let us, for instance, divide the sciatic nerve, and all the parts below the division will have lost not only all sensation, but all power of motion; or if we suppose the divided nerve to supply an organ of secretion, that function is also destroyed. Thus, a division of the gastric branch of the eighth pair destroys digestion, while a similar operation on the pulmonary branches causes the animal shortly to die asphyxiated. It is equally demonstrable that any alteration in the proportions or physical properties of the blood, by modifying or rendering morbid one of the great exciting forces of nervous action, is equally a cause of disease. Thus, on injecting a quantity of water into the veins of an animal it falls into dropsy; the abstraction of a portion of fibrine causes inflammation; while the loss of any considerable portion of the red globules is well known to produce most marked debility. It seems determined, therefore, that any departure from a healthy state of the solids or fluids is equally the cause of disease; and hence the necessity of admitting the leading features of solidism and of humoralism, as well as of vitalism, as fundamental principles of Medicine. It will now, consequently, be necessary to point to a few of the more striking facts connected with these theories.

In the examples which have been given, demonstrating the influence of the solids in the production of disease, the nerve has been supposed to have suffered considerable mechanical injury; but it seems probable that the slightest change in the action of the nerve is sufficient greatly to modify the action as well as the

secretion of the organ or part it supplies. Now the probable mode of action of a nerve is as follows:—

Anatomy has shown that the brain and nerves are fibrous; and a fibrous structure almost of necessity implies action or contraction. But, independent of this argument, there are many beautiful phenomena, especially of sight, which seem to prove that vision and sensation generally result from a physical action or contraction of the nerves, whether of the eye or other organ. Thus, if we look steadily at a target composed of concentric circles of various colours, placed in a strong light, till the sight is somewhat fatigued, and then close the eyes, shaded by the hand placed at about an inch distance, we shall see, says Darwin, the most beautiful circles that imagination can conceive, and which are most resembled when a drop or two of oil is poured on a still lake on a fine day. These circular irides of colour, however, are not only different from those of the target, but are perpetually changing till the eye recovers its usual passive state. These adventitious colours are called the reverse, or supplemental colours. This and similar facts show that vision is not owing to the mechanical impulse of light, or to its chemical combination with the nerves of the retina; for in those cases the spectra formed on the eye would remain of the same colour, only growing fainter and fainter, till they at last disappeared altogether. The probable explanation, therefore, of these phenomena seems to be, that the retina is composed of many sets of nervous fibres, and that when the set whose contractions, for instance, cause the sensation of red is fatigued, it is relieved by the action of an antagonist set whose contractions cause the sensation of green, in the same manner as we relieve the muscles of the arm by changing its position and bringing a different set of muscles into action. Another circumstance, also, which seems to demonstrate that the contraction of the nerves constitutes vision, is, if we press the ball of the eye at its external angle a luminous appearance is observed; while, if the eye be struck a smart blow, we all know flashes of fire are perceived. Now, the sensation of fire thus produced is entirely the result of mechanical causes, light or other natural stimulant being altogether absent. It follows, then, that vision is produced by contractions of the fibres of the optic nerve; and this mode of action, proved to be true of the sense of sight, may be equally demonstrated of the nerves of the other senses, and also of those of the different organs of secretion. It results, therefore, if a healthy action of the nerves (the great moving and secreting powers of the body) be essential to health, that every morbid action of the nerve must be a cause of disease.

The contraction of a nerve, however, although it may account for sensation and secretion, is hardly sufficient to explain the great power imparted to and exercised by the muscles; for if we consider how soft and tender and little coherent the brain and nervous fibres are, and also how easily the muscular fibre is torn after death, something more is wanting than mere muscular contraction to explain the infinitely greater power which the muscular fibre is capable of exciting during life than after death. Sir Isaac Newton was of opinion that the cohesion of bodies depends on the presence of elastic fluids; and this opinion is strengthened, if not completely established, by modern discoveries, for a continued stream of electric fluid will enable a magnet to support a mass of iron, of any weight, for an almost indefinite time. It seems probable, therefore, that nervous contraction is followed by the extrication of a fluid which is the cause of vital cohesion of parts, and of the wonderful force which the muscles exert in moving and raising bodies.

It is singular that the electric fluid, so powerful an agent in producing cohesion of inanimate substances, is also the great agent of chemical composition and of decomposition; and likewise that this fluid is evolved by mere change of motion in the particles of matter. It seems highly probable, therefore, from analogy, that a nervous fluid is extricated in like manner by a molecular motion or contraction of the nerves, and that this fluid is the cause, not only of nervous and muscular cohesion, but is also the great agent of the vital compositions and decompositions which are incessantly going on in every part of the body. Again, when we observe that heat is given off by most inorganic substances after a smart blow, which approximates their particles, we may almost infer that nervous contraction may be one of the means which nature employs to regulate the temperature of the body.

If the theory of a nervous contraction, followed by the extrication of a nervous fluid, be established, the one may be taken as the measure of the other, and the term "nervous sensibility" may be used to express their conjoint effect. This nervous sensibility, it would appear, then, in health, is accumulated by repose and exhausted by action; so that, at times, it may be considerably in excess or in defect. If, for instance, we sit in the dark, the sensibility of the retina is so greatly increased that the eye is actually pained by the admission of a strong light. On the contrary, if we look at the sun, the sensibility of the retina is so absolutely exhausted by the intensity of its rays, that for a time we are blinded to every other object. This property of accumulation and of exhaustion of nervous sensibility is often extremely sudden, or otherwise exists in a most marked degree in disease. Thus, nothing is frequently more unexpected in its attack than a paroxysm of wild insanity, of epilepsy, of hysteria, or of tetanus; while fainting, or the last stages of fever, are familiar examples of collapse, and of the rapidity with which the nervous energy is exhausted.

The hypothesis of a nervous fluid seems to lead to the inference that this elementary principle may be rapidly communicated from one part to another. In health, the action of the brain, in determining a greater quantity of nervous fluid to a particular part, is quite remarkable. Let a black spot, for instance, about the size of a tadpole, be made on a sheet of white paper; that spot, if looked at attentively, will be seen in a few seconds surrounded by an areola of light; a circumstance which can only arise from the retina being rendered more sensible by the increased quantity of nervous energy communicated to it from the brain by the power of attention. In like manner, it is well known that the times of the action of the bowels, the times of eating, and so on of the other functions, may in a considerable degree be accelerated or retarded in proportion as we direct our attention towards those purposes. It is this power of the brain over distant parts which renders the nervous and hypochondriacal person so prone to exacerbations and remissions; for, by constantly brooding over his complaint, a flood of cerebral or nervous energy is directed to the diseased part, and all its morbid sensibilities are immediately

aroused. If we pursue this subject further, it will be easy to show that a powerful action of any one part may readily exhaust the whole system, terminating, perhaps, in almost sudden death. A person, for instance, has strangulated hernia, or a small ulcer of the intestine; the part is not vital, nor the pain great, yet in a few hours the patient lies a corpse.

It would be extremely difficult to exhaust the interesting subject of the action of the solids; but there are two points which it is essential to lay before the reader, as they instance remarkable laws of the neuroses. The first is, that sensation, though almost constantly *passive*, and in health only brought into action when some external agent is present capable of acting upon the nerve, yet is in some instances *active*, or exists when no external agent having any affinity for the nerve is present. Thus, we are often sensible of tastes in our mouths, although we have not eaten the particular substance, perhaps, for some months. In like manner, in insanity, the patient often hears and sees persons and things which have no real existence. Another familiar example of active sensation is, that persons who have lost a limb (as the leg), are often sensible of painful or agreeable sensations, which they refer to the foot, although that part has perhaps been long removed. In all these cases the sensation is evidently active, the nerve taking on those actions by which such sensations were accustomed to be transmitted to the brain. It is, perhaps, owing to this law that a part, having been once diseased, readily runs into the same morbid state, not only when the exciting cause is present, but also when it is absent.

The next remarkable law is, that sensation is not, as is generally imagined, instantaneous; but, like every other function, is performed in certain times. The sensation of sight, for instance, is not instantaneous, for we many times in an hour cover our eyes with our eye-lids without perceiving it, so that the perception of light is not changed for that of darkness in so short a time as the twinkling of an eye. On the continent it has been remarked, that different astronomers observing the passage of a star over the thread of a micrometer by the same clock have varied a third, a half, and even a whole second as to time—a discrepancy, says Nicolai, which can only be accounted for on the supposition of a difference of time in the transmission of the image of the star from the eye to the brain, and also of the sound of the clock from the ear to the same organ.

In disease, the times of the action of the brain are often greatly increased or diminished. In idiotcy, and other forms of insanity, and also after many other severe disorders, the apprehension of the patient is often distressingly slow, while in acute cases the patient will hardly sleep day or night for many weeks together from incessant activity of mind. Again, if we look to the other functions of life, as to defæcation or to digestion, we shall find that the organs on which they depend act only at certain times, long intervals of repose being necessary to renew their power after action. The stomach, for example, in the adult, can only digest three or four times a day, for if pressed beyond a given point food is loathed. In bulimia the appetite can hardly be satiated, while in fever the patient hardly digests anything for many days. The action of the bowels, also, instead of taking place every twenty-four hours, may be incessant, or it may be deferred for several days or even weeks. The law of healthy animal functions then is to remit; and when the natural times are disturbed, disease is the consequence. It is this tendency of diseased actions to remit which so often occasions a difficulty in determining whether the recovery of the patient is owing to medicine or to a natural subsidence of the disease, and it is to this cause we must attribute the endless " nostrums " which disgrace the practice of physic.

Such is the probable action and a few of the laws of the nerves in the neuroses. The few facts relating to the alterations of the blood in this class of disease with which we are acquainted are as follows:—Andral supposes the mean quantity of fibrine in healthy blood to be 3 parts in a thousand; of red globules to be 127; while of the solid contents of the serum, 71 parts are albumen and about 9 parts are free alkali, or other saline substances. Now if we take plethora and anemia to be the extreme points of the constitution in the neuroses, we shall find the natural and healthy proportions of the blood sensibly altered in these states. Thus, in thirty-one cases of well marked plethora, Andral found the proportions of fibrine diminished to 2·7 instead of 3, while the mean of the red globules was as 141 instead of 127. On the contrary, in sixteen slight cases of anemia the red globules were reduced from 127 to 109, while in twenty-four well marked cases the mean was only 65, and in one case they had fallen as low as 28. Again, the quantity of fibrine in the sixteen slight cases was natural, or as 3; while in the twenty-four well marked cases it was increased, or as 3·3. In general, then, in the neuroses the characteristic of the plethoric extreme of the blood is a less quantity of water and of fibrine, and an increased quantity of red globules; while in the anemic extreme the water and fibrine are increased, while the red globules, and probably also the albumen, are greatly diminished. The blood also in this latter state is sometimes slightly buffed, and the globules smaller than in health.

It is singular, in the neuroses the opposite extremes of plethora and of anemia are often marked by nearly the same symptoms as tinnitus aurium, vertigo, palpitation, and hysteria. The different states of the constitution, however, distinctly mark these opposite conditions.

Besides the symptoms common to plethora and anemia, Andral conceives he has determined a law peculiar to anemia, or that, when the red globules of the blood are below 80, the *bruit de diable* is constant, and heard in every artery in the body. When they are about 80 this *bruit* is still constant, but is heard only in the carotid arteries. Again, when the quantity of blood globules is above 80 and below 125, the *bruit*, though still heard in the carotids, is not constant but intermits; while above 125 he conceives the *bruit* ceases altogether.

The facts which have been mentioned will, it is hoped, turn the attention of the student, and awaken his curiosity to the great elementary principles of the Neuroses,—a class of disease usually of long duration, without fever, often strikingly formidable in their symptoms, and in many instances the cause of much suffering. They are generally difficult of cure, and it will be seen for the most part aggravated by bleeding, and assuaged by opiates and tonics, but under any circumstances have a strong tendency to recur.

ORDER I.

OF THE NEUROSES.—CLASS I.

Of Insanity.—Esquirol has defined madness to be a cerebral affection, ordinarily chronic, without fever, and characterized by disorders of the intellect, of volition, and of the senses. A moral as well as a pathological definition, however, is necessary of this disease, and in that view it may be defined to be that state of mind which renders a man an irresponsible being, and consequently unfits him for the performance of the social and political duties of life. The amount of disease necessary to constitute this state must often rest with a jury; for every faculty of the mind may be diseased, as the memory, the judgment, the imagination, and the power of associating ideas, yet the party may continue to be a most useful and even valuable member of the commonwealth.

The history of insanity shows that it is of very early origin. Saul was unquestionably insane; and so familiar does this disease appear to have been among the Jews, that David, to escape from Achish, king of Gath, feigned himself mad: "and he changed his behaviour before them, and feigned himself mad, and scrabbled on the doors of the gate, and let his spittle fall down his beard. Then Achish said unto his servants, 'You see the man is mad.'" The insanity of Hercules, of Ajax, of Medea, and of Orestes, must have been traditional before it became the subject of poetry, and shows that the disease was common even in the fabulous ages of the Grecian annals. In modern times it is a disease unhappily of frequent occurrence, and has, though perhaps erroneously, been supposed to be extended in proportion to the degree of civilization. The numbers that died from this complaint in England and Wales, in the year 1839, amounted, however, according to the Registrar-General's Report, to only 424, or 226 males and 198 females.

Remote Cause.—The remote causes of insanity are moral and physical. Of 5653 patients principally admitted into the different hospitals of France, Italy, and Belgium, 558 arose either from falls or blows on the head, from the abuse of mercury, or other physical causes not determined. The other 5095 cases all arose from moral causes, as religion, crossed in love, jealousy, family disputes, reverses of fortune, wounded pride, disappointed ambition, anger, fright, arbitrary detention, excess of study, libertinage, and drunkenness.

The action of moral causes in producing insanity is so striking that the passing events of the day often give the peculiar characteristic of the disease. When magic and witchcraft were believed in, Europe was overrun with persons who supposed themselves possessed by the devil. On the death of the king of France and his unfortunate family, the hospitals swarmed with dauphins destined to succeed him on the throne. The trial of the Duc d'Enghien made many insane impersonators of that illustrious person; and when the Pope was at Paris, that singular event caused many religious monomaniacs—a form of Insanity, says Esquirol, which shortly after disappeared.

Predisposing Causes.—The principal predisposing causes are age, sex, hereditary descent, and disease.

Age.—Infancy is nearly exempted from madness, and so also is childhood, except in cases of congenital idiotism. Esquirol, however, gives the case of a child between five and ten years old whose monomania lay in attempting to destroy both her father and mother. Insanity, however, as a general principle, seldom breaks out till after puberty, and when the passions are fully developed. Leuret gives the following table of the ages of 11,687 insane patients.

Under 20	1,007
From 21 to 30	2,541
,, 31 to 40	3,438
,, 41 to 50	2,293
,, 51 to 60	1,185
,, 61 to 70	819
,, 71 to 80	364
Above 80	40
	11,687

Sex.—It has been much disputed which sex is most liable to insanity; but Esquirol, from returns obtained from the different insane establishments of London and Paris, considers the numbers to be nearly equal, the number of males attacked being 6335, and of females 6892,—a result which is remarkable, considering the influence which menstruation, pregnancy, and suckling have in the production of this disease, and which Esquirol estimates as accounting for the insanity of one-sixth of the whole number of women attacked. As an approximation to the influence of social position on the patients, 44 women were unmarried, 80 married, and 20 were widows. Of the males 61 were unmarried, 123 married, and 8 widowers; which shows a larger proportion of insanity among the unmarried than among the married population in proportion to their respective numbers.

It has been thought, also, that the maniac was more particularly affected at the full of the moon; but Esquirol thinks the exacerbation attributable merely to the light, for when that is excluded the patients are as tranquil as at other times.

Hereditary.—The testimony of almost universal experience establishes the fact of a very general hereditary transmission of insanity. This is remarkably instanced among the Catholics and Quakers of England, and also among the high nobility of France, who almost in every instance intermarry, and are allied by blood to each other, inculcating a sad lesson to those parents who consult, in the marriage of their children, the interest rather than the health of their descendants. This hereditary tendency to insanity in the aristocracy is greatly insisted on by Esquirol, who states that out of 321 pauper female lunatics, only 105, or one-third nearly, were ascertained to belong to families in which insanity had previously existed; while out of 264 females of the higher classes, 150, or more than one-half, were thus connected. In general, children born before the insanity of their parents are less liable to this disease than those born after the attack; also children born of parents diseased in one line are less liable to it than parents diseased in both lines. The condition of the mother also during gestation has often a striking effect on the mental health of her future offspring; for Esquirol observed that during the French revolution many pregnant ladies whose minds were kept constantly in a state of alarm and anxiety during that epoch, brought forth children which, in their infancy, were subject to spasmodic, convulsive, or other nervous diseases; and in their youth either to madness, imbecility, or dementia, and almost without an exciting cause.

Certain diseases also are powerful predisposing or even exciting causes of insanity, as epilepsy, which gives rise to a large number of the most incurable cases

of madness. Insanity also often alternates with phthisis—the one disease becoming latent in proportion as the other becomes active. Derangement of function, or structure of the uterus, is also a powerful predisposing cause. Many persons also become deranged after severe fevers; while Foville states that five-sixths of those he examined had more or less disease of the heart, showing the powerful effects of intemperance and of strong passions in the production of this mental affection.

Pathology.—The cranium of the insane patient is occasionally found extremely thin, and occasionally greatly thickened; but except in a few cases, especially in idiots, its conformation and size is natural. On opening the cranium, all authors, whether English, French, German, or Italian, are agreed that in a given number of cases, however severe the malady may have been, not a trace of disease, either of the brain or its membranes, is to be met with. The proportion, says Calmiel, may be small (eight times in seventy-five), but still it is enough to prove that insanity is merely a functional disease of the brain, and also to lead to the inference that the lesions of that organ are, in many cases, the consequence of the high excitement and violent exertions of the patient rather than the causes of disease.

When any lesion exists, it is principally slight inflammation of the arachnoid and pia mater, with effusion into their cavity, generally of serum, or of serum with points of lymph, and less commonly of a gelatiniform substance. These lesions are more frequently found at the anterior and superior portions than at the base of the brain. The lesions next in frequency are thickening and opacity of the arachnoid, with effusion of serum in large quantities into the ventricles, sometimes doubling or trebling their capacity. The dura mater is also strongly adherent to the cranial bones.

The substance of the brain is generally healthy, but in acute cases sometimes strongly marked by many puncta cruenta. Again, often on removing the arachnoid, a small portion of the corticle substance, strongly injected, is detached with it. In many cases the brain is softer than natural; and in a very few cases so loaded with serum that Leuret has been enabled to express that fluid from it in considerable abundance. In a very small number of cases the brain is harder than natural. When the patient has fallen from paralysis, the lesions are similar, but occasionally traces of apoplectic effusion have been found.

Such have been the lesions commonly observed in insanity; and if it be asked whether they in any degree explain the seat of the intellectual faculties, they certainly do not, for the same appearances are often observed in patients who have in no degree suffered from insanity. Neither has anything been observed which could in any instance fix or confirm Gall's theory of the localization of the cerebral phenomena, for the same lesion often exists in forms of insanity totally different from each other.

Symptoms.—Insanity has many different forms, and is divided into monomania, mania, melancholia, and dementia.

It is hardly possible to understand the nature of insanity without first considering that every sense is liable to be diseased, as light things to feel heavy, small things to seem large, hot things to feel cold; or else that the senses are liable, from the irritation of the brain or other cause, to become *active*, the patient seeing persons or hearing discourses when no such person is present, and no such discourse is related. When he is satisfied by reasoning and the evidence of his other senses that what he hears or sees is an illusion, he is said to labour under an hallucination. When, however, he believes and acts upon them, he is insane. The following are a few instances of hallucination:—

Every sense is liable to the disease of hallucination. Dr. Falconer mentions a case in which cold bodies felt intensely hot to the patient; he could not move but he was burnt. Esquirol mentions a lady who, being recommended a lavement, was desirous of administering it herself. No sooner, however, was the syringe put in her hands, than she threw it away with an expression of horror, stating it felt so heavy that she believed it to be filled with mercury, and that they wanted to make a barometer of her body. A gentleman, whose mind was in every other respect perfect, had constantly the sensation of his mouth being full of pieces of broken glass; while another, curious in his table and choice in his wines, believed everything tasted of porridge. A lady labouring under phthisis quitted lodging after lodging, being everywhere annoyed with the smell of burning charcoal. The sight also is often the seat of hallucination. Dr. O'Connor met with a patient recovering from measles, to whom every object appeared diminished to the smallest possible size. While Baron Larrey mentions another person who saw men as big as giants; and again, another party on recovering from typhus, felt himself to be ten feet high, his bed eight feet from the floor, and the opening of the chimney as large as the arch of a bridge. The celebrated Pascal always believed he saw a precipice on his left hand, and always had a chair placed on that side to prevent his falling into it. The ear, also, the organ that hears "The airy tongues that syllable men's names," is likewise often affected. A gentleman riding by a barracks at evening call never got the sound of the bugle out of his ears for nine months; and everybody knows that Dr. Johnson always entertained a deep impression that, while opening the door of his college chambers, he heard the voice of his mother, then many miles distant, calling him by his name, "Sam! Sam!"

It is remarkable that these hallucinations sometimes occur when the organ is itself destroyed. Esquirol, for example, attended an insane merchant who, though labouring under gutta serena, not only heard persons talking to him, but saw visions that perfectly enchanted him. He had also under his care a Jewess, who was blind, and yet saw things the most strange. She died, when the optic nerve, from its anterior point of decussation till it entered the globe of the eye, was found atrophied, so that the transmission of any exterior impression was impossible. He mentions also two other women absolutely deaf, who had no other delirium than that of hearing every night sundry invisible persons that addressed them.

Such are instances of hallucinations, and the images thus excited are as vivid as those produced by external causes, so that the patient when insane entirely believes the empty and false forms he sees, the ideal sounds he hears, to be real and substantial. Nothing can persuade him of their fallacy; but, like Macbeth, he insists, "If I stand here I saw him." It is only by the occurrence of a temporary hallucination that we can explain the apparition of the ghost of Cæsar to Brutus, promising to meet him at Philippi; or the existence of the familiar

spirit which conversed with Tasso. It is probable, also, that such hallucinations formed a portion of the psychological phenomena occurring in the cases of Luther, Ignatius Loyala, and Swedenborg. Out of 100 insane persons, 80 at least labour under hallucinations of one, two, or even of all the senses. Thus they are perpetually holding conversations with imaginary beings, seeing ecstatic visions, fighting with enemies ready to destroy them; and in a few instances an angel of light is at one ear, and the angel of darkness at the other. Some, again, smell all the odours of Arabia, while to others everything they eat tastes of human blood, or of raw flesh, or is gritty with arsenic.

In insanity, also, if a part be diseased, the imagination often personifies it, and converts it into some strange reality. Thus, a young woman who suffered from pain in the crown of her head was convinced it was caused by a worm gnawing her brain. An old general, who believed the sun was the cause of all his ills, suffered occasionally pain in the knee; and in one of these paroxysms he seized the pained part with one hand, and striking it with the other cried out, "Ah! rascal, you shall not escape me now!" evidently conceiving his knee to be a thief. There are constantly in the hospitals patients who, suffering pains in the stomach, believe that organ to be filled with serpents or frogs. One man complained his stomach was filled with mice, when a friend advised him to swallow a cat. A woman, for many years a lunatic at Salpêtrière, and who suffered severely from abdominal pains, believed she had a whole regiment of soldiers in her abdomen, and when the pains were severe that they fought with each other. Another woman, called by the patients "Mère de l'Eglise," believed to have in her entrails all the personages of the New Testament, and occasionally those of the whole Bible: when her pains were exasperated, she sometimes cried out, "Je n'y puis plus tenir quand fera t'on la paix de l'Eglise;" and at others she believed the Popes held their councils in her abdomen. This patient died, when the abdominal viscera were found adherent to each other and to the peritoneum; and the same appearances were found in a woman who believed her abdomen was filled with devils.

Of Monomania.

Having thus stated the nature of hallucinations, we must now proceed to the consideration of insanity, and first of monomania, or that form of the disease in which some one passion or hallucination so entirely possesses the patient as to lead to erroneous and often dangerous conduct. The modes of this affection are endless; some being beset by jealousy; others desperately in love, and sometimes with entirely imaginary objects; others seek their own death or the destruction of other people, or have an uncontrollable desire to commit petty thefts, or to set everything on fire. These varieties are termed kleptomonia, pyromania, autophomania, and erotomania, and so on, according to the passion or imagining of the patient. We shall only be able to give a few of the endless varieties of this disease.

Hypochondriasis is a disease of the sense of touch, combined with a morbid imagining, so that the patient believes himself to be strangely metamorphosed, changed into some inanimate thing, or else loses all knowledge of his personal identity; and this form of disease is sometimes combined with other hallucinations. The odd conceptions of the patients under these circumstances are singular enough. Men have imagined themselves to be so much butter or putty, and in the one case to be unable to bear heat for fear of melting, and in the other have forborne to walk lest their legs should be crushed by the weight of their body. One man kept the house imagining he was too large to pass through a given door-way; and when he was pushed through he screamed, affirmed his flesh was torn from his bones, and actually died of fright. One man imagined he was Aldgate pump, that his arm, which was in perpetual motion, was the handle, and bitterly complained that the inhabitants would let him have no rest morning, noon, or night. Another, that he was a seven-shilling piece, and went round to his neighbours hoping, if his wife should bring him to their shops, they would neither take him in payment nor give change for him. A third supposed himself transformed into a beer-barrel rolled along the streets. A fourth, that he was a mutton-chop, and insisted that his wife should take him daily to the butcher to be trimmed. Bishop Warburton speaks of a person who thought himself a goose-pie, a circumstance referred to by Pope in his sketch of Hypochondriasis:—

> "A pipkin there, like Homer's tripod, walks;
> Here sighs a jar, and there a goose-pie talks."

Among other singular forms of hypochondriasis is a belief in an absolute change of sex. Dr. Arnold saw a man who fancied himself in the "family way;" and Esquirol speaks of a male patient who fancied himself a woman, and felt insulted if the slightest liberty was taken with his dress. Some have thought themselves converted, like Nebuchadnezzar, into wild beasts.

In every madhouse there is a last surviving woman; a last man overwhelmed with grief and horror at having out-lived the whole world. Some patients imagine they have no soul, others no body, others that they are absolutely dead. One gentleman approaching his 90th year so far lost his mind that he assembled his family around him and announced to them that he was dead; begged, in communicating the sad intelligence to his absent friends, they would say he went off easily, and expressed himself a little scandalized that the windows were not closed on the occasion, and entreated, as a last favour, for one pinch more out of his favourite snuff-box before he was finally screwed down. Sometimes the supposed deceased party is resuscitated. One man, who received a severe wound at the battle of Austerlitz, believed he had died, and that the body he had now got was not his own, but some machine *mal faite*. Another, that he was guillotined during the French revolution, and had not only lost his own head, but, somehow or other, had got a new one. A third, that his head had been put on his shoulders with the face towards his back; and, lastly, some think they have not only lost their heads, but see them rolling on the ground.

It is seldom, however, that insanity is of so simple and harmless a nature; for more commonly the affections and feelings are subverted, and the persons most dear to us by the ties of relationship become hateful to us; while the mind is more commonly swayed by some destructive passion to effect some object criminal in itself. This state of the feelings may or may not be accompanied by hallucinations. The most extreme form of this description of monomania is androphomania.

Androphomania.—Gall gives the case of a man at Vienna, who, after witnessing a public execution, was

Elementary Principles of Medicine.

seized with an uncontrollable propensity to kill, although he had a clear consciousness of his situation, expressed the greatest aversion to commit such a crime, shook his head, wrung his hands, and cried out to his friends to keep away. Pinel mentions the case of a person who exhibited no other unsoundness of mind than this propensity to murder; so that his wife, notwithstanding his tenderness for her, was near being destroyed, he having only time to warn her to fly. In the intervals of the paroxysm he expressed every remorse, was disgusted with life, and attempted several times to put an end to his existence. A man was tried at Norwich in 1805 for wounding his wife, and afterwards cutting his own throat, an act so repugnant to his nature that he had been known to tie himself for a week together with ropes to avoid it. Esquirol mentions a woman seized with sudden paroxysms of phrensy to destroy her children, and only saved them by locking the bed-room door and throwing the key away. Metzyer has a similar case of a nurse who requested to be discharged, and on explanation she gave as a reason that every time she undressed the child, struck by the whiteness of its skin, she had an irresistible desire to rip open its belly. The deadly purpose with which the monomaniac is seized is accomplished in many different manners and times. Sometimes the murder is long premeditated, and the victim marked out, the patient concealing a knife about his person till an opportunity for effecting his object presents itself, though that period be remote. In other cases the destructive propensity seems the result of a sudden paroxysm. Esquirol gives the case of a man relapsed into insanity, who on returning from the cellar seized a boy on the stairs by the hair, and after a few seconds let him go, saying, "Il ne vaut pas le peine." The next day he sent his wife and sister to the cellar, when he followed and murdered them, saying subsequently in explanation of the act that the cellar seemed to him all on fire. The same authority also mentions the case of a maniac who was sitting round the fire with the other patients, when he suddenly seized a chamber-pot and broke it over his neighbour's head; fortunately he was immediately secured. In a lucid interval he stated he had made this homicidal attempt in consequence of his brothers having appeared to him at that moment crying out "Kill him! kill him!" Other patients, again, are so aware of the approach of the attack, that they entreat to be confined in order that they may not commit the mischief to which they seem irresistibly impelled.

Autophomania.—Many monomaniacs, besides being impelled to destroy others, have an irrisistible propensity to destroy themselves. A gentleman who was cheerful, amiable, well-informed, and reasoned well on every other subject, made many attempts to commit suicide, giving as his reason "Je m'ennui." This patient, however, had hallucinations both of sight and hearing, imagined he was pursued by the police, and believed even to hear them through the walls of his apartment. Many of these unfortunate persons, not having resolution to put themselves to death, have killed others in order to suffer a judicial death. One woman, who reasoned, "in order that I may die I must kill some one," attempted to kill both her mother and her children. Some of these tragedies are perfectly terrific. A man in a paroxysm of insanity killed his wife and three children, and would have killed the fourth had it not escaped. After these horrible sacrifices he ripped open his own belly, but the wound not being mortal he again drew out the instrument and pierced himself through and through. This man had enjoyed a good education, and was of a mild character.

It is singular that the propensity to commit suicide is in some persons so great that many destroy themselves although in possession of fortnne, of station, of objects of affection, and apparently in every other respect in the fullest enjoyment of their reason.

The ingenuity of the maniac in providing means for his own destruction is often singular. Some have thrown themselves under the wheels of a waggon; others have drowned themselves in an incredibly small quantity of water; others have most ingeniously strangled themselves; and others, more closely watched, have swallowed all sorts of heterogeneous articles—pins, needles, bits of broken glass, nails, buckles, and any and every hard substance they could force down their throats. Pinel gives the case of a man who had cut off one of his hands with a hatchet before his arrival at Bicêtre, and afterwards in spite of his bonds attempted to tear the flesh off his thigh with his teeth.

Pyromania.—The derangements of feeling and of reason may take other forms than murder; and arson is one of the more common. Some seem impelled to this criminal act by the mere sensual gratification of the excitement, confusion, noise and bustle consequent on the conflagration. One lad committed repeated acts of arson solely from the delight he took in the blaze, the ringing of the bells, and in the thronging of the people. At Cambridge, there was a student who was said to have attempted to set fire three times to his chambers, and probably from this cause. Often, however, it results from a process of reasoning, or from some hallucination of the senses. The destruction of York Cathedral by Martin was effected under a feeling of divine impulsion, and of his being commissioned to purify the House of the Lord. One maniac set fire to his bed, thinking to escape in the confusion it would cause, and another from believing that, like Shadrach, Meshach, and Abed-nego, the flames would respect his person.

Kleptomania.—Some have an irresistible desire to steal. Gall mentions that the first King of Sweden was always stealing trifles. The wife of a celebrated physician at Leyden never went into a shop without stealing; and a countess at Frankfort had the same propensity. It is related of a physician that his wife was always obliged to examine his pockets in the evening, to restore the things she found there, for he always took something else as well as his fee.

Esquirol gives the case of a lady of an exactly opposite character. Her insanity consisted in a ceaseless dread of appropriating what did not belong to her; she therefore combed her hair an endless number of times in the day, examined her dress minutely every time she put it on or took it off, felt in her shoes, turned up the chairs, looked under her plate, and thus consumed many hours in the day in endless cares, lest something of value might have adhered to her dress. Such are some of the forms of this wonderful malady, whose varieties are endless. The most common are theomania, chrysomania, doxomania, demonomania, erotomania. Thus, some govern the sun, the moon, and the weather; others are savans, distinguished by their discoveries or inventions; others poets or orators, whose discoveries we must listen to under pain of their displeasure; others are kings or emperors, commanding

the universe, and giving protection and dignities to those who surround them; others are submitted to the gentler sway of love, and believe themselves to sojourn among the sylphides and houris; others are gods or prophets in communication with heaven, and the immediate agents of some Divine commission; while others are the separate or conjoined persons of the Holy Trinity.

Mania, Melancholia, and Dementia are forms in which the powers of the mind are more generally overthrown, and the senses more commonly affected by hallucinations. In many instances the association of ideas is either so destroyed that the patient is in a state of complete delirium, or else the judgment is erroneous, the memory impaired, and the affections perverted.

It is seldom in mania that the patient, as in monomania, is only insane on one subject. His mind, says Esquirol, is a perfect chaos; all is violence, effort, perturbation, and disorder. He confounds time and space, associates persons and things the most unnatural, creates images the most unreal, and lives isolated in feelings and reasoning from all the rest of the world; his actions also are often wicked; he hates all that he loved, and wishes to overthrow and to destroy everything. The female lunatic, also, perhaps in health the model of candour and virtue, gentle and modest, an affectionate daughter, a devoted wife, and a good mother, becomes in this disease bold and furious, exposes her person unmoved to the gaze of every eye, is blasphemous and obscene, respects no law either of decency or humanity, and threatens her father, strikes her husband, or perhaps murders her children.

The following case is detailed by Esquirol as one of the most general examples of melancholia. A young woman, aged twenty-three years, lived in the country, but had been frightened by some soldiers. For four years afterwards this young person had scarcely been heard to utter a word, and the few she did utter seemed expressive of the terror she was still possessed with. At first she obstinately refused to quit her bed or to eat, but when obliged to get up she went and seated herself on the same bench, and always maintained the same attitude, her head being inclined to the left side, her arms crossed and resting on her knees, and her eyes fixed on the ground, and in this position she remained the whole day. She never asked for food, and it was always necessary to bring it to her and to press her to eat, but still in eating she preserved the same posture, except that she used her right hand. At no time did she ever answer any question. It was necessary to tell her to go to bed; when she undressed, rolled herself up like a ball, and then buried herself under the clothes.

Of *Dementia*, the following may be taken as a specimen. A merchant, after some losses in trade, became perverted in his affections, neglected his business, and refused to eat, for fear of being poisoned, and, indeed, committed all sorts of excesses. This state of excitement was followed by a state of depression, during which he stood by his bedside, his head bent forward, his arms hanging by his side, his eye vacant and fixed, and his countenance unchangeable. This was followed by another paroxysm of excitement, in which he spoke incessantly; abused his family; walked with a rapid step; overthrew all in his way—laughed—stopped—heard and saw his enemies day and night, and especially his mother, who reproached him. The stage of depression again came on; he slavered from the mouth and nose; his urine was passed involuntarily; he refused to eat or drink, or to undress himself, and when placed in bed, lay all night in the position he was first placed in; kept an absolute silence, and at length fell into a state of stupor, from which nothing could rouse him.

Almost all persons suffering from dementia have a *tic*. Some walk incessantly, seeking something not to be found, while others can scarcely drag their legs after them; others walk round and round eternally in the space of a few feet; while others lie rolled up in bed, or extended on the ground. Some write incessantly, but the words or sentences have rarely any connexion or meaning; others talk incessantly, but incoherently, beginning a sentence without being able to finish it; or so completely is the association of names with things lost, that they utter nothing but what Hamlet would call "words! words!" one will strike his hands day and night, while his neighbour will balance his body in one position with a most tiring monotony of movement; another will weep and laugh, whistle, dance, and sing during the whole day; others, again, dress themselves in all sorts of whimsical manners; while others will display a few rusty nails or common pebbles as the riches of the universe. The gradations of this form of madness are, first, a chaotic state of the faculties; secondly, the loss of all sense of propriety; and, lastly, the entire oblivion, or nearly so, of every spark of intelligence.

In dementia the patients are extremely liable to become paralytic; and an affection of the tongue, denoted by a thickness of speech, is the first symptom. After a time, the speech is more manifestly affected, and is followed by a loss of power in the limbs of one side, more marked in the lower extremity, so that their step is feeble and straggling. In the last stage they are completely paralytic, and only able to utter a few unintelligible sounds. Of 120 paralytic cases of dementia 13 were in the first stage, 52 in the second, and 55 in the third stage of this calamity.

Looking to insanity generally, it is seldom that the ideal character assumed by the patient is well sustained; more commonly it is little more than the name. In a few cases, however, it is well supported, and the prophet assumes a tone, energy, and attitude suited to the envoy of the Almighty, and the emperor the majestic step and deportment corresponding to his fantastic regal state. In these instances he almost always sees visions, or is visited by invisible interlocutors, to whose dictates he generally becomes fatally obedient.

Whatever form insanity may assume, like other diseases it may be divided into three stages. The first stage may be sudden in its attack, sometimes almost instantaneous, but more commonly it is marked by a short prelude of an indefinable aberration from health both of body and mind; for the patient, besides being out of health, is easily excited, is headstrong, and ready to commit every sort of extravagance. In the second stage the disease is formed; while in the third stage the patient, if he recovers, becomes more docile, more natural in his affections, sleeps better, and takes more food; or else the disease may become inveterate, incurable; or epilepsy, palsy, or other phenomena may unexpectedly terminate his existence.

The attack of insanity may last many weeks, many months, or many years, but in most cases it has a tendency to remit; and hence authors have divided this disease into continued, remittent, and intermittent.

The remittent form differs from the continued by the fact of remissions more or less marked. Thus many patients are violent by day, yet are calm and tranquil at night; while others, on the contrary, are tranquil by day, but are sleepless and violent at night. Sometimes the remission is only every second day, when it takes place with great regularity. This tendency to remit has been remarked by Shakespear:—

> "This is mere madness;
> And thus awhile the fit will work on him;
> Anon, as patient as the female dove
> When that her golden couplets are disclos'd,
> His silence will sit drooping."

Again, the paroxysm of insanity is sometimes so regular as to assume an *intermittent* type, occurring every week, every month, every three months, twice a-year, or every one, two, three, or four years, often without any other known cause than the return of the period.

Diagnosis.—One of the great difficulties of diagnosis in this disease is to distinguish monomania from sanity; for, with the exception of some given morbid delusions, the patient may be rational on all other subjects, and in some instances even the powers of his mind are increased. One celebrated instance of this kind occurred to the late Lord Erskine. The lunatic had indicted a most affectionate brother, together with the keeper of the madhouse, for false imprisonment. He was placed in the witness box, and Lord Erskine, not instructed in what his lunacy consisted, consumed the whole day in fruitless attempts to expose his infirmity. At length Dr. Sims came into court, and suggested to the learned counsel that the patient believed himself to be the Lord and Saviour of mankind. Lord Erskine then addressed him in that character, and lamented the indecency of his ignorant examination, when the patient expressed his forgiveness, and with the utmost gravity and emphasis, in the face of the whole court, said—"I am the Christ!" In a similar case, tried before Lord Mansfield, the patient evaded the questions of the court the whole day, till Dr. Batty arriving, asked him what had become of the princess with whom he corresponded in cherry-juice. Instantly the man forgot himself, and said it was true he had been confined in a castle, where, for want of pen and ink, he had written his letters in cherry-juice, and thrown them into the stream below, and that the princess had received them in a boat. These answers of course immediately terminated the cases. It is plain, therefore, that we shall often be foiled in examining an insane patient unless we make some previous inquiry as to the points on which the party is deranged.

Prognosis.—As a general rule, the younger the patient the greater the chances of recovery; but above the age of fifty few are cured. Of those that recover, the exciting cause often greatly influences the result; thus most recover when it proceeds from drunkenness, provided the patient can be restrained from drinking; and also if it arises from slight moral or physical causes. When, however, the shock is severe, the recovery is less certain, and if combined with epilepsy or any organic affection of the brain, recovery is almost impossible. The form of the disease also greatly influences the result, for when the patient suffers from hallucination, the chances of recovery are much diminished. Taking insanity generally, the maniac has been cured in the ratio of 1 in 2·05; the monomaniac as 1 in 1·78; the melancholic patient as 1 in 2·33; and the stupid as 1 in 3·33. If, when labouring under dementia, the patient be seized with palsy, Esquirol knows of no instance of his surviving a twelvemonth after the first symptom, or the affection of the speech.

The mortality among the insane appears to be infinitely greater than that of the population generally, and on a calculation of nine years at Bicêtre, an hospital containing 1200 patients, the annual deaths were as 1 in 6·7 cases. The largest mortality is from dementia, the least from monomania; in the latter, indeed, where there is no tendency to suicide, the duration of life is little abridged, so that premature death is almost in all cases owing to accidental causes.

Treatment.—The treatment of insanity resolves itself into the medical, the moral, and the dietetic treatment.

All the best and most candid practitioners admit that medicine has very little direct action on the brain, so as favourably to influence the course of the disease; but indirectly, however, by regulating the different actions and secretions of the other organs, and thus improving the general health, the happiest results are often obtained. Thus, when the bowels are constipated, the mode of treatment is determined by the state of the tongue; or, supposing it to be white and coated, the sulphate of magnesia, or other neutral salt, combined with tinct. hyoscyami in the proportion of ʒj. of the former to ♏xv. to ♏xxx. of the latter out of camphor mixture is among the best remedies; but any other purgative or opiate, in corresponding proportions, may perhaps be equally serviceable. If, on the contrary, the tongue be clean, the cathartic should be given with some slight bitter, as the infusi aurantii or the infusi gentianæ comp. In some cases the bowels are not only exceedingly obstinate, but the patient is greatly averse to all medicines, and now one or two drops of croton oil placed on the tongue produces free evacuations, and prevents the necessity of employing violence.

The mild purgative treatment formed the basis of cure in the school of Pinel and of Esquirol, and they usually combined it, in cases of violence, with the application of cold to the head and of warmth to the lower parts of the body, such as placing the patient in the warm bath and giving him the cold douche. The further treatment consists in restoring any other functions that may be in defect or in excess, as the functions of the uterus in the female, and of the liver or heart in both sexes, and by the usual remedies applicable for those purposes.

Most practitioners are agreed, as a general principle, that bleeding ought to be avoided. The continental physicians are entirely averse to it, as increasing rather than calming the excitement, and tending to produce organic changes of the brain, rather than to cure or prevent them. In this country it was formerly the custom to bleed the patients in spring and fall; and Crowther states he has bled 150 at a time, and that the blood in every case was free from any inflamed appearance. There was also the absence of all inflammatory character in the blood of 194 patients out of 200 bled by Dr. Haslam. In the present day some difference of opinion prevails as to small but none as to large bleedings. "When loss of blood," says the late Sir William Ellis, "is excessive, the vital power in numerous instances is never recovered, and the patient sinks into a state of fatuity, or dies. Unfortunately, many patients received into public hospitals as recent

cases, have previously undergone this exhausting process, the constitution has not energy to rally, and there is a much greater mortality among the recent than among the old cases, in proportion to their number and ages. There is a much greater probability of an ultimate cure when nature is left to herself, and the violence of the attack allowed to be expended, than when her powers have been wasted by excessive depletion." The same authority also adds, " As far as my experience extends, I have not seen any advantage arise from the use of blisters upon the head during the paroxysm. They appear rather to create irritation than to allay it, and they prevent by their application the use of cold water or of ice, which has often the most salutary and instantaneous effects." And, again, with respect to opiates, " That medicine which will allay watchfulness in one will not in another, but, on the contrary, increase it. This is particularly the case with opium, which is rarely found admissible in insanity. It more frequently creates heat and general febrile action than sleep." In cases, however, of recent excitement, morphia in considerable doses has been found most beneficial.

The moral treatment is by many supposed to constitute the more principal means in the cure of insanity, and it must be admitted to be a most important adjunct. The first important rule is to remove the patient at once from his family; in slight cases, in order that he may be induced to exercise such command over himself as he possesses; and in severe cases, in order to prevent his doing mischief either to himself or others. In the latter instance, if the patient be excited, it is proper to place him at once in a dark room, and remote from noise, in order that there may be as few objects as possible to rouse and fix his attention.

When it is necessary to confine the patient, an overwhelming force should be procured; for a maniac often believes himself to have supernatural powers, and will often fight against one or two persons, when he will feel it useless to resist three or four. The usual mode of confinement is the strait-waistcoat, or a pair of canvas sleeves joined by a broad shoulder-strap, the part covering the hands being made of stiff leather, to prevent the patient grasping anything, or a pair of leather hand-cuffs. It is sometimes necessary to secure the feet, when a couple of leathern straps, well lined with wool, placed round the ankles, and secured to staples in the bedstead, is all that is necessary. Occasionally, the body must be secured; when a thick quilt should be thrown over the clothes, and fastened by three leathern straps on each side. When the patient is able to sit up, an easy mode of confinement is an arm-chair, each arm being hollowed out and made to open so as to contain an arm of the patient. In this manner each upper extremity, as well as the trunk, can be fastened, while the legs may be secured to a foot-board, which, if perforated with holes, will enable us to apply hot water constantly to the feet.

When intervals of reason are established, the patient should be encouraged to exert all the self-command he possesses, by great kindness and attention, and by sometimes punishing his faults and his follies by slight privations; and when the patient is visibly not doing his best, or is malicious, the cold douche has often excellent effects, and any improvement should be rewarded by increased indulgences. As the convalescence advances, he should be induced to undertake some manual labour, or some office in the household, which, by amusing his mind, and invigorating his health, greatly tends to his restoration. When the circumstances of the patient admit of it, travelling, which embraces change of air and change of scene as well as exercise, is often highly salutary in incipient cases. Much has of late been spoken of the introduction of music and other amusements into asylums. Esquirol, however, who made many experiments of this kind, induced the musical professors of Paris to perform concerts at Salpêtrière, and also took his patients to the theatres, but considered these amusements in every instance to have acted unfavourably. When reason is restored, and the affections again fix themselves on their natural objects, the patient may now be allowed to see his friends, and have his attention directed to the affairs and interests of his family; but it should be remembered that the mind remains weak and enfeebled for some time after apparent recovery, and consequently the patient's restoration to society should be gradual.

Dietetic Treatment.—In general the patient requires a light but nourishing diet, with a limited portion of wine. When, however, the head aches, or the tongue is coated and white, neither meat nor poultry should be allowed.

Epilepsy

Is a sudden and complete loss of all consciousness, with convulsions.

This disease has been known from the earliest antiquity, and is remarkable as being that malady which, even beyond insanity, was made the foundation of the doctrine of possession by evil spirits both in the Jewish, Grecian, and Roman philosophy. The number of adults that fell from this disease in England and Wales, in 1839, was 1186, of children, 25,408,—making a total of 26,594.

Remote Cause.—When epilepsy is the result of a powerful original tendency, it often occurs without any apparent cause, and when the patient is in his best health. The effects of moral causes in its production are so well known that Raphael has introduced into his picture of the Transfiguration, a boy falling into an epileptic fit. Besides moral causes, errors in diet, excess of any kind, blows on the head, every structural or functional disease of the brain, and especially insanity; or any severe disease, as fever or small-pox, are all powerful remote causes. In children, the irritation of teething is the most common cause.

Predisposing Causes.—The large number of children that die of this disease has been mentioned; and indeed in France epilepsy is termed " mal des enfans." The next most frequent period of life is puberty; and its frequency, perhaps, as a primary disease, decreases from that time till 50, when it again increases, from the tendency the brain now has to insanity and to structural disease. As epilepsy is common in idiots whose heads are deformed, it has been affirmed we are liable to this disease in proportion as the facial angle approaches to 70°. There are many exceptions, however, to this law, as witness the fine head of Napoleon.

It is supposed that in infancy, and under seven years, it occurs in nearly equal proportions in both sexes. After puberty, when the distinction of sex is marked, some authors contend it is more common in males than females: Dr. Elliotson thinks in the proportion of 27 to 11: Esquirol, however, says, on comparing the number of epileptics at Bicêtre and at Salpêtrière, the number of women attacked was one third greater than of the men.

It is also a very general opinion that this disease is hereditary.

Pathology.—It has been affirmed that in 15 out of 20 cases, in which the brains of epileptic patients have been examined, the structure of that organ has been in every respect healthy. Even when the patient has died during the paroxysm, the brain has in many instances only been found congested. Epilepsy is therefore merely a functional disease, and being a purely functional disease its particular seat is not determined. But although epilepsy may exist without any disease of the brain, or of its membranes, it must be admitted that the brain and its membranes are occasionally found in every state of disease to which those parts are liable. Thus, the membranes may be inflamed, thickened, or ossified, with every form of effusion to which they are liable; or the substance of the brain may be indurated or softened —the seat of abscess, of cancer, of tubercle, or of other structural disease—and of which the epileptic attack is merely a symptom.

Symptoms.—Epilepsy has no varieties, but it may be grave or slight. The attack of this disease often occurs without any previous warning; so much so that Georget estimates, that in 95 cases out of 100 there are no premonitory symptoms. Many patients, however, on the approach of the fit have vertigo or headache; some swelling of the veins, or beating of the arteries of the head; while others have ocular spectra or affections of the other senses.

Dr. Gregory used to mention, in his lectures, the case of an officer whose paroxysm was always preceded by the spectre of an old woman dressed in a blue cloak, who issued, as he imagined, from the corner of the room, and knocked him down with her stick. Dr. Fothergill attended a Quaker who always fancied he saw his garb covered with spangles before he fell into the fit. These ocular spectra are very numerous; but the most common are flashes of light, tadpoles, flies, coloured areolæ around the flame of the candle, black dogs and white horses. Others have hallucinations of the ear, as the ringing of bells, or the roaring of the sea, while others again are annoyed by the smell of disagreeable odours, or by the sensation of unpleasant tastes.

When the sense of touch is the seat of the hallucination, the term "aura epileptica" is used to express it. In these cases the patient has often the sensation of a fluid creeping from the fingers or toes upwards towards the trunk; others feel as though a spider or other insect were crawling over the skin. Dr. Elliotson speaks of a patient that had two auræ, each of which ran along the dorsum of each foot, ascended up the front of the legs and thighs to the trunk, where they broke into five streams, all of which again met at the epigastrium, and, having reached this point, he fell into the fit. These sensations appear to reside in the skin, and not to follow the course of any particular nerve.

Esquirol met with a case, a woman, in which the prodrome was the patient's turning round for a considerable time; and another, in which the party ran with all his might, till at length he fell down, overpowered by the disease.

In the *adult*, whether these warning symptoms be or be not present, the attack usually commences by the patient uttering a cry, losing on the instant all consciousness, and falling down in convulsions, his mouth being covered with foam. The convulsions vary from the most trifling and transitory convulsive movement, to the most frightful, terriffic, and long-continued struggles. In mild cases only one limb is convulsed: in others only the face, the lip, or the eye. Esquirol gives the case of a lady whose fits were so slight that although often seized on horseback she never fell off. In a few seconds she was recovered, and resumed the conversation by finishing the sentence she was expressing. In this case, however, the epileptic cry and the convulsed eye denoted the true nature of the attack. One lady, advanced in life, suffered from fits so slight, that she preserved her seat in her chair; so that, except some slight convulsive motions about the mouth, followed by a short sleep, the attack would have passed unnoticed. Attacks so mild often occur many times in the day, last about five minutes, and leave no feeling of ill health behind.

In severe forms of the disease the convulsions are more formidable; the hair stands on end, the forehead is wrinkled, and the brow knit. If the lid be opened, the eye is seen injected, sometimes convulsively agitated, at others in a state of strabismus, and sometimes fixed: more commonly the lid is quivering, half open, showing the white of the lower portion of the conjunctiva. The face is red, or livid and swollen; the teeth generally clenched, and the mouth covered with foam; sometimes, however, the mouth is open, and the tongue thrust forward; and should the masseter muscles now act spasmodically, it may be bitten through, or otherwise much injured, and the foam consequently be mixed with blood. The force with which the jaw closes is so great, that the teeth have been broken and the jaw luxated. The limbs also are violently convulsed, thrown about in every direction, and with such power that it often requires three or four persons to prevent the patient seriously hurting himself. In these convulsions, also, his hands are strongly clenched, and his body often arched backwards, as in opisthotonos; and in this case, on the muscles relaxing, he falls to the ground with great force. While the limbs and trunk are thus powerfully agitated, the muscles of the chest are spasmodically fixed, and hardly admit the act of respiration.

The functions of organic life are not strangers to this scene of tumult and terror. The pulse is generally frequent, sometimes hard and intermittent, and at others scarcely perceptible, although the heart beats strong and tumultuously. The respiration is stertorous; the stomach and bowels troubled with borborygmi; the skin inundated with sweat, while the urine, semen, or fæces, are occasionally emitted. Blood also sometimes flows from the eyes, ears, or nose, frightfully expressive of the violence of the attack.

When the paroxysm has reached its crisis, the muscles relax, the convulsions subside, the respiration becomes more free, the pulse more regular, and the countenance more natural; and at length the patient falls into a heavy sleep, from which he awakes sometimes in good health, but more often shaken, exhausted, and suffering from severe headache, which lasts some hours or some days. In neither case, however, has he the slightest consciousness or remembrance of what has passed. In other instances the termination of one paroxysm is but the beginning of another, and the succession is occasionally so continued that the attack, with short intermissions, may last twenty-four, forty-eight, or even more hours.

When *Children*, from teething or other cause, are seized with epilepsy, the attack is often preceded by a

spasmodic affection of the larynx, causing the hooping or crowing sound so well known to every practitioner; but it may and often does take place without any warning. In the former case, the child perhaps is in his best health, but on awaking is seized with the characteristic hoop, often accompanied by a spasmodic flexion of the thumb against the palm; or else the fingers are clenched, or the toes bent. These symptoms may occur a varied number of times, till at length, with or without this warning, the eye is seen staring, fixed, or convulsed; the face and extremities pale or livid; the hand clenched, the body rigid, and the head and trunk curved backwards. The fit is now formed; and if we examine the fontanelle, we find it distended and pulsating. These symptoms generally last only a few minutes, when a strong expiration takes place: a fit of crying succeeds, and the child, much exhausted, recovers its consciousness, and, after a short interval, generally falls asleep. These convulsions seldom occur during the early periods of lactation, nor until the period of the child cutting his teeth, nor after three years of age.

The duration of the paroxysm is very various. In children they seldom, as has been stated, last more than a few minutes. In the adult they often do not exceed that period; but in many cases they last half an hour to two hours, while in others the greater part of the day passes before the paroxysm terminates.

It seldom happens that the paroxysm occurs but once. In the mildest case in the child, it is commonly repeated three or four times in the course of the first three or four years of childhood, while in other cases it will occur three or four times in the day; and in severe cases the child is hardly out of one fit before it falls into another, till at length they gradually subside. In the adult, the frequency of the fit varies extremely in different patients. In some instances there is an interval of several years; at others it returns annually, or every six months, or mensually, weekly, or even daily, while others will have twenty or thirty fits in the course of the same day. The paroxysm, however, returns not only periodically, but also at every irregular interval. The period of the day the attack takes place is also very varied, for it may occur during the day, at night, when asleep, or in the morning, when just awaking.

Such are the laws relating to the paroxysm; but epilepsy is not only frightful from the violence of the symptoms, but also from the serious effects it may produce on the moral character as well as on the physical frame of the unhappy patient. Thus, some fall into the fire and are burnt to death; others into the water, and are drowned; others give themselves a black eye, or other bruise; while, in some cases, a limb has been fractured. Many epileptics have a convulsive action or *tic* of the muscles of the face, or their legs waste and are unable to support the weight of the body. In some instances the leg has been flexed under the thigh, a contraction which has lasted more than a year, while, in others, the patient has become paralytic. A case of this latter description occurred lately in St. Thomas's Hospital, in a woman about 40, who had not only lost entirely the use of one side, but although she retained her voice, and understood what was said to her, she was incapable of uttering an articulate sound.

Aretæus, in describing with his beautiful perspicuity the symptoms of epilepsy, has not neglected to speak of the baneful influence of this disease on the intellect, of the memory being lost, of the imagination being impaired, and of the functions of the brain being, in many patients, so subverted that they fell into incurable insanity. Esquirol gives the cases of 385 epileptics under his care, in the hospital Salpêtrière, and he states that four-fifths were more or less insane. The remaining fifth had preserved their reason, but, he adds, "a reason so broken!"

Diagnosis. — Epilepsy is to be distinguished from apoplexy and hysteria. It differs from apoplexy by the violent convulsions which accompany it, and by the foaming at the mouth; and from hysteria by the absence of the rising of the throat, of the screaming, laughing, and crying peculiar to that disorder. It must be admitted, however, that the diagnosis between these diseases is often difficult.

Prognosis.—Epileptic convulsions during teething generally subside about the second or third year; children, likewise, first seized between three and four years old, are often cured, or it often subsides at puberty, except when hereditary. Hippocrates imagined that epileptics attacked after puberty are incurable, and this is certainly the fact when epilepsy is conjoined with insanity. Pregnant women attacked with epilepsy are in great danger.

Treatment.—The treatment divides itself into what is to be done during the paroxysm, and subsequently during the interval.

The best practitioners are of opinion, when adults are labouring under the paroxysm, that, in general, little can or ought to be done except bringing the patient into fresh air, taking off what may be around the neck, and baring the chest, together with the more imperative duty of preventing the patient doing himself any injury. Bleeding, so often had recourse to, except in parturient women, is rarely found beneficial, and is supposed, in many instances, to prolong the attack. If, however, the paroxysm be greatly prolonged, cold to the head, and opening the temporal artery, may be of some service.

The paroxysm passed, the probable cause should be investigated, and if possible removed; the state of the bowels should be particularly inquired into and regulated, and leeches should be applied to the temples, if the headache be severe. In women, also, the menstruations, if defective or excessive, should be remedied. These few simple rules are of the first importance, not only as removing the immediate inconveniences incident to the attack, but also as a means of prolonging the interval, and, perhaps, preventing its future occurrence. In a few instances, the patient by their adoption is cured; but too commonly the fit returns, and then it must, in candour, be admitted that the pharmacopœia at present furnishes no efficient curative remedy. The most usual analeptics are valerian, iron, zinc, quina, misletoe, musk, opium, assafœtida, mercury, the iodide of potash, camphor, æther, and the preparations of turpentine. The argentum nitratum, once esteemed a specific in this complaint, has not only failed, but, by occasionally staining the rete mucosum of a dingy blue, has often permanently disfigured the patient. Of the long catalogue which has been mentioned, each medicine is, perhaps, useful for a few weeks; but after that period its good effects are, for the most part, lost; so that it would appear to act rather mentally than physically, or through the influence of the imagination than potentially, in removing the cause and altering the action of the brain.

In cases in which epilepsy is conjoined with insanity, every attempt at the cure of the patient has been painfully unsuccessful. Esquirol states that, at Salpêtrière, he tried, on 339 epileptics, "bleeding" in all its forms, purgatives of all kinds, baths of all temperatures, as well as every kind of vegetable or mineral antispasmodic. But, as the result of his great experience and vast variety of practice, he found that every new remedy suspended the access for about a fortnight, and, in some cases, for one, two, or three months. After these periods, however, it always returned, so that he never saw one case in his hospital practice cured, nor was he more successful in his private practice; for although the paroxysm was often suspended by the confidence inspired by consulting a new physican, yet the remission or suspension was short, and the disease always re-appeared. He concludes that hysteria may have been mistaken for epilepsy, and been cured, but not epilepsy itself.

With respect to local or derivative treatment, as issues, setons, and actual cautery, he states that, when Pariset went to Cadiz to investigate the nature and causes of the yellow fever, raging in 1821 in that town, he was left in charge of Salpêtrière, when he found 20 epileptics treated with two, three, or more moxas on the vertex of the head, which had burnt down to the external table of the skull. These wounds he kept open with great care, but not one patient was cured. In a young epileptic, whose fits were preceded by an "aura" commencing in the great toe, he cauterized that part down to the bone. The aura epileptica disappeared, but the paroxysms became more frequent and more violent.

Although the medical treatment of the adult is so unsatisfactory, yet the treatment of epilepsy occurring in children during teething is almost always successful. The practice, on the child falling into a fit, is immediately to place it in a warm bath, and to pour cold water on its head, to lance its gums, and to throw up an enema. These means generally bring the child to himself; and the after-treatment is to apply a few leeches to the head, to purge it with calomel, either alone or combined with some other cathartic, and to diminish the quantity and quality of its diet. These means are all the case admits of, and they are very generally successful. Bleeding, it should be remembered, should be used with great moderation, for these fits seldom affect the intellect, and have a tendency to subside spontaneously in a very few months. When depletion, however, is carried to excess, the child's health is greatly broken, and the probability is, that the brain is rendered more irritable and the fits more frequent. Slight opiates, by soothing the irritation of the mouth, are useful in every stage of the complaint, and when greatly debilitated some mild tonic treatment may be necessary to restore the little patient.

Dietetic Treatment.—In the adult the diet should be light, and the patient live remarkably temperate. The diet of the child should be, if possible, its mother's milk, with or without arrow-root. If above three or four years of age its diet should consist entirely of farinaceous or other vegetable matters.

Hysteria

Is a nervous disorder, commonly of a paroxysmal character, in which the patient experiences the sensation of a ball rising in the throat, or a feeling of suffocation, which may or may not be followed by convulsions, during which she laughs, cries, screams, and although apparently insensible, yet generally retains much consciousness of what is passing around her.

This disease is mentioned by Hippocrates in his "Natura Muliebrum," by Plato in his "Timæus," and also by Galen. It is likewise treated of in the works of the earliest modern writers on medicine. No death from this disorder is to be found in the reports of the Registrar-general.

Remote Cause.—The remote causes of this affection are rather moral than physical; and in a young person predisposed to the disease almost any mental emotion will excite it, as anger, disappointment, jealousy, protracted expectation, the loss of a husband, a friend, or a child; indeed, all that brings the passions into play is a cause of this disease, and many women cannot go to church, or witness a tragic representation, without suffering from their "sex's fits."

Predisposing Causes.—This disease almost exclusively attacks females between the ages of 15 and 45, or during the most sexual period of woman's life. The parties most liable are the unmarried, and of these those that labour under amenorrhœa or menorrhagia. The married woman often suffers just after conception, or before parturition, or subsequently from protracted suckling. The barren woman, however, is most liable, and probably from her mind being acted upon by a greater number of exciting causes. Taking classes of women, the higher classes, from their higher living, artificial breeding, and false estimate of life, are greater sufferers than the lower classes.

But although this is a disease almost peculiar to woman, it is not entirely so, but occasionally affects the "nobler sex." Shakespear has made Lear exclaim, when Glo'ster relates the cause of his being put in the stocks—

> "Oh, how this mother swells up toward my heart!
> *Hysterica passio!*—down, thou climbing sorrow
> Thy element 's below!"

It sometimes also occurs in minds less torn by passions, and of less vigour than Lear's, and is not unusual in men of weak constitution and feminine habits. One remarkable case of this kind occurred some years ago in St. Bartholomew's Hospital, in which the patient, a tailor, when seized with the paroxysm, not only shouted, screamed, hallooed, but actually, by the force of his gluteal muscles, would jump his heavy bedstead into the middle of the ward.

Pathology.— It is seldom the patient dies from hysteria, but occasionally women have, in their moments of ungovernable feeling, fallen by their own hands; some by cutting their arms across so deep as to divide the brachial arteries, and others by other means, as hanging or poisoning Nothing, however, has been discovered, on the most minute examination of the body, to account for this affection. It is, therefore, merely a disease of function, or one of the neuroses.

In speculating on the seat of this affection, the ancients supposed it to be the uterus roaming about the body in search of impregnation. Looking, however, to the excited state of the passions, the general convulsions of the whole body, and the affection of the eighth pair, there seems no doubt its seat must be in that mass whose influence is so universally felt all over the body or the brain.

Symptoms.—The forms and degrees of hysteria are

so numerous that the difficulty of describing this disorder is very great. The modifications of age, temperament, states of nervous sensibility, physical and moral education, and grades of society so influence it that it is only possible to give a most general outline. It is usually divided into three forms: or, first, the globus hystericus without convulsions; secondly, into its paroxysmal form, or the globus hystericus with convulsions; and again, into those irregular and anomalous forms which often manifest themselves during the intervals.

The milder forms are those which terminate without the formation of the paroxysm. They commonly begin with pains in the epigastrium, in the left side, or in some other part of the abdomen; or else the patient is generally nervous, her feelings excited or depressed, and these symptoms having existed for a greater or less length of time, a ball, the "globus hystericus," rises apparently from the lower portion of the abdomen, and proceeds upwards with various convolutions to the stomach, and thence to the throat, causing a sense of suffocation. At this point the slighter forms often stop, but are frequently followed by headache, stiffness of the neck, general weariness, a profuse discharge of a light-coloured limpid urine, and by great flatulence, the patient often becoming almost instantaneously distended with wind.

When hysteria assumes a paroxysmal form or "fit," it may be preceded by the pains and mental feelings which have been described; but not unfrequently the attack is sudden, and often caused by some momentary and transitory occurrence. In these cases the patient bursts out into a fit of immoderate laughter or crying, the globus hystericus then rises, and no sooner reaches the throat than she falls to the ground apparently unconscious, and violently convulsed. The fit is now formed, and, in delicate women, the convulsions are easily controlled, but in the strong and plethoric many persons are necessary to restrain the patient, who writhes her body to and fro, agitates her limbs in various directions, and beats her breast repeatedly, commonly the right, with her arm and hand. During the fit the patient also often knocks her head against the bed or floor, tears her hair, screams, shrieks, laughs, cries or sobs alternately. The respiration is slow, and rendered still more laborious by spasms about the pharynx and glottis, so that the patient often grasps her neck and throat, or rubs or strikes the epigastrium and left side with her hand. During this struggle she often bites her own arms or those of the bystanders, and, if left to herself, will sometimes travel all round the room, by means of the gluteal muscles, on her back. The abdomen is often singularly distended with wind; but, in other cases, the abdominal muscles are tense and irregularly contracted. The pulse is, in some cases, increased by the violence of the exertion, but in others its beat is natural. The veins of the neck are distended, the carotids beating with more than usual violence, and the face is flushed. The temperature of the extremities is often lower at the commencement than natural, so as to cause a momentary shivering; but as the paroxysm forms the heat is usually restored and sometimes increased. The phenomena of the subsidence of the paroxysm are very various; sometimes attended by a flood of tears, a fit of laughter, or by an exclamation; and if this is followed by a great flow of limpid urine, the recovery is generally rapid and complete. In other cases the action of the stomach becomes inverted, so that the attendant, perhaps watching the patient with the tenderest sympathy, receives its whole contents in his face, after which she sinks into a profound sleep. In others, again, the fit only partially passes off, and the patient lies, to a certain extent, sensible of what is passing about her, but jaw-locked, the secretions of urine suspended, unable to talk, and obliged to be fed.

The fit having subsided, the patient lies exhausted and unwilling to be disturbed, and although more or less conscious of what has passed, she wishes to be thought ignorant of all that has taken place. A want of consciousness may exist when the fit assumes a severe or epileptic form, but this is not a common symptom of the pure hysterical convulsion. In some few cases the patient is delirious, and makes the most extraordinary noises, as barking; but this is probably feigned. The duration of the fit is very various, or from a few minutes to two, three, or more hours. These fits readily recur, and no sooner is one ended than the patient often falls into another; and in this manner the whole attack may last twelve, twenty-four, or even forty-eight hours. In general the intervals are much longer, not subject to any general law of recurrence, except they are more common about the period of menstruation.

In the interval the symptoms are extremely anomalous and irregular, and more strange and difficult to describe than even those of the paroxysm. Some have their senses so acutely alive, that although the window and bed-curtains may be drawn, still they are pained with light, and the slightest noise distresses them. In some, again, the sense of touch is so exquisite that they can scarcely bear the weight of the bed-clothes; and to others odours are similarly intolerable; so that to—

"Die of a rose, in aromatic pain,"

is not the mere feigning of the poet's imagination. Besides this extreme acuteness of the senses, others suffer pains under the mammæ, lumbar pains, pains in the hip-joint, headache fixed to one spot, and termed clavus hysterica—palpitation. Pain in the region of the spine is also frequent, and often so intense and so exquisitely increased by pressure that it has often been mistaken for ulceration of the intervertebral cartilages; and Sir B. Brodie has seen numerous instances of young ladies condemned to the horizontal posture, and to the torture of issues and setons for successive years, whom air, exercise, and cheerful occupation would have cured in a few weeks.

As to painful affections of the joints, the same high authority states, that at least four-fifths of the females among the higher classes, who are supposed to labour under diseases of the joints, are suffering from hysteria and from nothing else. The morbid sensibility is chiefly in the integuments, and if they are slightly pinched or drawn from the subjacent parts, the patient complains more than when the head of the femur is pressed against the acetabulum. There is likewise no wasting of the glutei muscles, nor flattening of the nates, nor painful starting of the limbs. In some instances the patient becomes paraplegic in the lower extremities, and is unable to walk, while others suffer temporarily from hemiplegia.

It is the extreme acuteness and exquisite sensibility of the senses in hysteria which has led those less skilled in female arts to believe in the many instances of animal magnetism which have formerly and lately attracted

Elementary Principles of Medicine.

so much public attention. One of the most celebrated of them was enacted a few years ago by Miss M'Evoy, of Liverpool, who, being very hysterical, of exquisite nervous sensibility, and thus enabled to see at very low lights, professed to read with her fingers, a power which many ladies in France have recently claimed, as if the peculiar mechanism of the eye was unnecessary to the formation of the image of external things. The late attempts also to establish the existence of a new nervous principle, or of a mesmeric fluid, are probably entirely founded on that high state of hysteria into which some young women are so easily thrown, and which, in many instances, they can produce at will; and that this will is not wanting in all cases is manifest from the following experience of Dr. Prout:—" Innumerable instances" he says, " have occurred to me, for example, in which calculi have been said to have passed from the kidneys and bladder by hysteric females. Such calculi I have examined, and found to consist, perhaps, of a fragment of silex or of brick; in short, of anything but what is known to be of urinary origin; and the symptoms have been so acurately simulated and described, that those who witnessed them or heard them described have not appeared to doubt of the reality, till the pretended calculus has made its appearance, when its chemical properties have at once dispelled the illusion. Sometimes the properties of the urine have been changed, and it has been mixed with blood or mucus, or with quick-lime or chalk, or with ink."

In investigating, then, cases of hysteria, we should constantly remember that the utmost duplicity and cunning may be displayed, when from mere appearances we should expect nothing but the most rigid truth; in short, the whole energies of the patient's mind are bent on deception; as to the motives for such deception, that is another question. To become an object of attention, an interesting object, is an innate and characteristic feeling of the female mind.

Diagnosis.—The hysteric fit is distinguished from epilepsy by the countenance being much less convulsed, and by the shrieking, laughing, and crying by which hysteria is so constantly interspersed. The foaming of the mouth is also wanting, and the patient in general remembers what has passed during the paroxysm. It is often difficult to distinguish between the many painful affections of the joints which arise from hysteria and the formidable diseases they similate, and many mistakes have been made fatal to the health and even to life. The character, however, of the party, her time of life, her general good health, the intermitting nature of the pain, and its following the course of the nerve, enable us generally to determine with much accuracy between these different classes of disease. The most common mistake, however, is that of considering the pains under the mammæ as pleurisy, or disease of the liver, leading to a sad abuse of bleeding, blistering, and the exhibition of mercury. The state of the pulse, however, the general good health of the party, and most commonly the existence of some uterine irritation, is a sufficient diagnosis between these different diseases.

Prognosis.—The ultimate result of these cases, though often long and tedious, is always favourable. In some few instances insanity has been the result of this highly excited state of feeling, but the instances of this termination are rare.

Treatment.—The treatment may be divided into what should be done during the fit, and into what should be done afterwards.

When the patient falls into a fit the first thing is to loosen her stays and everything tight about her person. The window should be opened and the cold air allowed to blow over her. She should then be laid flat on the bed, or on the floor first, as a means of rendering the circulation through the brain more equal, and again to enable us the more readily to control the convulsive movements of her body. This being done, many modes of further proceeding may be followed. Some recommend, in plethoric cases, that the patient be bled; a remedy certainly in many instances manifestly improper, and in all of doubtful efficacy. When the jaw is locked, an enema, consisting of half a pint to a pint of assafœtida may be thrown up, or, what Dr. Elliotson thinks still better, two or three ounces of oil of turpentine, which in some instances, he adds, instantly removes the affection, but in other cases not for some hours. Another remedy is to fill the mouth with salt: " You generally see them come round if you fill the mouth with salt." The remedy, however, which supersedes all others, and is unquestionably the best, is a good drenching. If the patient be on the bed, the head should be drawn over its side, and a large quantity of water poured on it from a considerable height out of a pail, jug, or other large vessel, and directly over the mouth and nose of the patient, so as to stop her breathing and compel her to open her mouth. This practice is generally introduced into hospitals, and till it was adopted it was not unusual to see three or four patients in hysteria in the same ward, and at the same time. Under that practice, however, an hysterical case is rare, and the fit seldom occurs twice in the same person.

After the paroxysm is over, if the patient complains of continued headache, a few leeches to the temples may be necessary, especially if the urine be small in quantity and high coloured; but in all other cases leeches, blistering, or cupping should be avoided as much as possible, as tending rather to aggravate than control the disease. The next object is to regulate the bowels by such purgatives as may be necessary, and at the same time to support and tranquillize the patient by mild stimulants, as æther or assafœtida, combined with some mild opiate as the tinct. hyoscyami, the syrup of poppies, or small doses of morphia. The state of the uterine functions is next to be inquired into, and if they are defective, salicinæ gr. x. three times a-day, or gr. x. of the citrate of iron should be exhibited ter die. On the contrary, if leucorrhœa be present, or the menstruation be profuse, the mineral acids, or the potassii bitartratis will be found most efficacious by restoring a more healthy state of the deranged organs.

The urine is often suppressed for a time after an attack of hysteria; but unless the bladder be sensibly, and perhaps painfully distended, no attempt should be made to draw it off. Something more should be hazarded to avoid this necessity, for the catheter once passed, that operation will require to be performed morning and night, perhaps, for several months to come.

Catalepsy

Is a rare form of disease, probably allied to hysteria, but whose laws and modes of treatment are not determined from the infrequency of its occcurrence. It will only be necessary to give a few exemplifications of this singular affection.

Catalepsy is a sudden suspension of all consciousness, and of all voluntary motion; but instead of falling down convulsed, as in hysteria, the patient, on the contrary, maintains the same position of the body, and the same expression of countenance he may chance to have at the moment of seizure; so that if sitting, he continues to sit; if standing, he continues to stand; and if occupied in any mechanical employment, he continues in that attitude; also, if the patient is under the influence of any passion of the mind, the countenance retains that expression—sic manus erecta non delabitur; faciei musculi ad risum aut fletum compositi risum vel fletum constanter exprimunt. This combination of fixed attitude and of unvarying expression gives to the patient the air of a statue rather than of a living being, and he appears as suddenly changed to stone as Niobe after exposure to the sight of Medusa's head. The most remarkable circumstance, however, in this disease is, that the attitude of the body and position of the limbs admit of being changed almost into as many new forms as a painter's lay figure, and the new position, however inconvenient, is preserved till again changed, or until the paroxysm has subsided.

Besides this singular state, all consciousness is suspended, and the patient neither receives any impression from external objects, nor retains any recollection of what has happened during the fit. The organic functions of life, however, continue to be performed, though feebly. The pulse and respiration are regular, only the former is smaller and the latter less frequent than in health. The colour of the countenance is either pale or undergoes no change. The fit may last a few minutes or a few hours, and is said to have lasted three or four days. The patient at length awakes as from sleep, and generally with a deep sigh, when all the functions of the body are suddenly restored. The attack is generally sudden and without any previous symptoms, but it is sometimes preceded by headache, stiffness of the neck, or some obvious torpor of the mind or body. The return of the paroxysm is very uncertain, but the disease seldom subsides with the first attack. The following case, given by Dr. Gooch, will best exemplify this affection.

A lady who laboured habitually under melancholy, a few days after lying-in was seized with catalepsy, and presented the following appearances. She was lying in bed motionless and apparently senseless. It was thought the pupils of her eyes were dilated, and some apprehensions were entertained of effusion on the brain, but on examining them closely it was found they readily contracted when the light fell upon them. Her eyes were open, but there was no rising of the chest, no movement of the nostril, no appearance of respiration. The only signs of life were warmth and a pulse, which was 120 and weak. Her fæces and urine had been voided in bed.

In attempting to rouse her from this senseless state, the trunk of the body was lifted up and placed so far back as to form an obtuse angle with the lower extremities, and in this posture, with nothing to support her, she continued sitting for many minutes. One arm was now raised and then the other, and in the posture they were placed they remained. It was a curious sight to see her sitting up staring lifelessly, her arms outstretched, yet without any visible signs of animation. She was very thin and pallid, and looked like a corpse that had been propped up and stiffened in that attitude. She was now taken out of bed and placed upright, and attempts were made to rouse her by calling loudly in in her ears, but in vain; she stood up, indeed, but as inanimate as a statue. The slightest push put her off her balance, and she made no exertion to regain it, and would have fallen had she not been caught. She went into this state three times: the first lasted fourteen hours, the second twelve hours, and the third nine hours, with waking intervals of three days after the first fit, and of one day after the second; after this time the disease assumed the ordinary form of melancholy.

It might be supposed that something of this might be feigned; but in the following case any suspicion of this kind was impossible. The party seized was an insane male hospital patient. This man was suspected of imposture; when one day, being attacked, he was placed upright on the edge of the cold bath, and gently pushed till he fell to the bottom like a stone, and continued there without the slightest effort to save himself, till it seemed no longer safe to continue the experiment. After continuing in a cataleptic state for many months this man recovered. Some few instances are given in which the patient has retained a partial consciousness during the attack.

No treatment has yet been determined for this complaint.

Chorea*

Is a singularly irregular convulsive action of the voluntary muscles, especially of the face and extremities, they being either entirely withdrawn from, or but little under the control of, volition. Fifty-four cases are reported to have died of this disease in England and Wales in 1839.

The history of this disease is a sad picture of superstition. As late as the close of the XVth Century, it does not appear to have been studied by physicians, but was supposed to depend on supernatural causes or diabolical possession. In Germany, it was said for two centuries to have been epidemic, and the patients, probably many of them maniacs, to have joined in frantic dances, and as late as 1673 they went in procession to the church of some favourite saint, of whom St. John, St. Guy, and St. Vitus were the most reputed. As physical remedies were supposed to be unavailing in such a disorder, the priests said masses, sung hymns, and sought to exorcise the foul fiend. Paracelsus is said to have recommended the afflicted to mould their own image in wax, to imprecate on it all their sins, and afterwards to burn it till every part was consumed. The moral effects of these methods must have been great, and no doubt many were cured in consequence.

Remote cause.—The disease frequently attacks children otherwise in good health, and without any obvious cause. When any cause is assigned, it is usually terror. Somebody has pretended to cut off the child's head, and perhaps has drawn the back of a knife across her throat; or a person dressed in a white sheet has enacted a spectre or ghost. The causes, therefore, producing this affection are chiefly mental. Mr. Mayo seems to think such a cause may produce the disease in a child yet in utero. A woman in the fourth month of her pregnancy had a frightfully disgusting object thrown at her bosom: she was for two months in a state of extreme nervous illness from this circumstance, but re-

* Χορος (*Cœtus Saltantium*) St. Vitus', St. John's, or St. Guy's Dance.

covered, and went her full time; remarking, however, that the child was extraordinarily lively in the womb, so that she was often overcome with the sensations she experienced. At its birth, the child, a girl, displayed the writhing motions of chorea, and continued up to the time Mr. Mayo saw her, when she was near thirty years of age, looking but an elderly child, with a head remarkably small, and a mind hardly removed from complete idiotcy.

Predisposing Causes.—Chorea is limited, or nearly so, to early life, and is rarely seen after twenty. Dr. Heberden states it to be most frequent between the ages of ten and fourteen, and also, that it is more common in the female than in the male, three-fourths of the patients under his care having been females. Dr. Elliotson says the ratio in his practice was eight males to twenty-two females; and these calculations are probably not far from the truth.

Pathology.—This disease is so constantly cured without leaving any trace behind, that it is unquestionably a disease merely of function. Rostan had once an opportunity of examining a woman upwards of fifty, and who, from her childhood, had laboured under chorea of all the left side of the body, and of which the limbs were atrophied. "I expected to find," he says, "atrophy of the right side of the brain, but there was nothing morbid; at least, after a most careful examination, I could see nothing." Dr. Bright has given one case, which he had an opportunity of examining, and which gives equally negative results. It was that of a young woman, aged seventeen, and who had formerly laboured under this disease. She had been free from it for four years, when she formed an attachment, was forsaken, attacked with chorea, and died. The attack was of great severity; she tossed herself about in all directions; bit her tongue, and was with difficulty in any degree controlled. On examination, there was a slight effusion into the arachnoid cavity, more puncta cruenta than usual, and five or six bony plates opposite the cauda equina; phenomena common to every disease of the brain or cord, and of course proving nothing.

Symptoms.—This whimsical disease principally consists in singular and involuntary movements of one or more limbs, which prevent the patient from being able to lay hold with certainty of any given thing, or to carry that thing, be it a spoon or a glass, with any certainty to his mouth, or to any other part. The lower limbs are generally as much affected as the upper, and he can with difficulty walk in a straight line, or if he does, it is always by a series of movements which tend towards the object, counteracted by another series which altogether diverge from it,—his feet turning in and out, upwards and downwards, or in every possible direction. The muscles of the face and neck are sometimes seized with this species of convulsion, when not only is the head tossed about, and the mouth contorted into the most singular grimaces, but it requires two or three persons to feed him, or one or more to hold him, and another to watch the proper moment to pop the food into his mouth. Sometimes the motor nerves of the fifth pair are affected, and then the jaw closes with a loud snap, or his articulation is affected, or the effort of swallowing difficult. Indeed, the patient is agitated by all sorts of odd motions, and has often a vacancy of countenance which gives him a fatuitous appearance. These convulsions are sometimes so violent as to render it necessary to tie him to his chair, or to strap him down when in bed. They are constant during the day, but when asleep, they generally cease altogether. In general, they affect both sides; but in a very few cases, one side only is affected, and the patient is then said to labour under a *hemichorea.* The child's health is generally good; his pulse natural, and his bowels, though occasionally constipated, are by no means uniformly so, but for the most part act regularly.

Diagnosis.—There is no disease which resembles chorea; but the variety hemichorea has been sometimes mistaken for hemiplegia.

Prognosis.—The recovery of the patient, with a very few exceptions, may be always prognosticated.

Treatment.—Sydenham prescribed three or four bleedings' for the cure of this disorder, and after the last bleeding he directed the use of cathartics and alteratives until the patient was completely cured; a treatment which has probably been found altogether ineffective, as it has been entirely abandoned. The next heroic mode of treatment was suggested by Dr. Hamilton, of Edinburgh, or that by repeated purgatives; but this method in London, at least, has been also unsuccessful, for although purgatives are occasionally useful, yet, as the basis of the cure, they have been found to do mischief rather than good. The practice, therefore, of the modern school is, for the most part, limited to the exhibition of tonic and stimulant medicines, and to the cold bath. The particular tonic is not of much moment, but in general the mineral tonics are preferred. The sulphate of zinc will cure a large number, beginning with a grain, in the form of a pill, three times a-day, and increasing the dose till it reaches seven or eight grains. This quantity may seem large for a child, but Dr. Elliotson says he has given 20 to 25 grains, three or four times a-day to adults on an empty stomach, and without its causing even nausea. The gradually increasing the dose is essential, for we thus act on the mind, which is, perhaps, of more importance than the addition of power over the body. The influence of the mind in curing chorea was strongly instanced in the use of the nitrate of silver, a medicine which was once prescribed to a great extent at St. Bartholomew's Hospital, for as long as the pupils took a deep interest in the cases by watching the effects of this apparently powerful medicine all the most intractable forms of chorea recovered. No sooner, however, was it shown that the nitrate of silver was readily decomposed by the saliva, and consequently rendered nearly harmless, and the pupils less anxious about its results, than all its good effects suddenly vanished, so that it has ceased to be, or nearly so, employed for the cure of this disease.

The sub-carbonate of iron has an equal if not a greater effect over the disease with zinc, and Dr. Elliotson thinks he has cured 40 cases in succession with it. He recommends it to be given from six weeks to two months, in drachm doses, and mixed with double its weight of treacle; and children, he says, after a time like it.

Of other classes of stimuli, camphor in five-grain doses has acquired much reputation. Many young women, also, who attribute the attack to fright, get well under so simple a treatment as misturæ camphoræ, and spiritus ætheris nitrici, ʒ j. ter die; and when they labour under amenorrhœa, salicinæ gr. x. ter die is equally or more beneficial. A few cases have done well under nucis vomicæ, gr. ij. ter die, but the catalogue of possible remedies is endless. In many instances,

however, the above medicines are continued for weeks without any manifest improvement, and in these cases the cold bath, or the cold shower bath is an excellent adjuvant, and, except the child is suffering from some structural disease, the case uniformly yields to this conjoined treatment.

Dietetic Treatment.—The diet should be light and nourishing.

TETANUS (*τεινω*) *extendo*—

Is a continued spasm of the muscles of the jaw, generally accompanied by intermitting spasm, either of all the voluntary muscles, or else of all the flexors, or of all the extensors of the body.

This disease was known to the ancients, and is described by Aretæus with all his usual terseness and precision. It is the frightful accompaniment of wars and battles, but occurs from accidents, or else spontaneously in a few instances in civil life, so that 122 cases are reported to have died from this disease in 1839 in England and Wales.

Remote Cause.—This disease is most frequently met with in armies on actual service, and is the result of wounds, especially of wounds made by large projectiles, as cannon-balls, bombs, &c., or of the amputations rendered necessary by those wounds. It follows also strains and contusions, and it is principally from these latter causes that it is met with in civil life.

Most authors consider it to be most common in hot variable climates, as that of Egypt. After the battle of the Pyramids, says Baron Larrey, upwards of 500 of the wounded were attacked with tetanus. The same authority also adds, that the tetanus of Egypt was much more intense than that he had observed in Germany. He states also, that this disease is much more common in all countries at those times of the year when the temperature passes rapidly from one extreme to the other, or in the spring, than in seasons when the temperature is more equal. Thus, after the battle of Eylau, fought during the depth of winter, not one of the guard, and very few of the line, were seized with this affection.

Besides wounds, strains, and contusions, some morbid poisons appear to produce this affection. Two men descended into a soap-boiler's vat to clean it out: on reaching the bottom, they both fell down in convulsions. They were quickly rescued, when it was discovered that a portion of sulphuretted hydrogen had been generated, and remained at the bottom of the vat. Both of these persons were seized with tetanus, of which they died. Strychnine is another poison also well known to produce this affection, and the poison of cholera, in severe cases, has also had the same result.

Predisposing Causes.—As the wound is the remote cause of tetanus, so its nature appears to predispose to the disease. Thus it is most common after injuries of the ginglymoid joints, as that of the elbow or knee, or when the bone is extensively fractured or comminuted. Its occurrence is also more probable if a foreign body remains in the wound, and especially if, after amputation, a nerve has been included in the ligature round the artery. In other respects, the state of the wound does not appear to influence the attack, for it appears to take place equally whether it be open or cicatrized, granulating or suppurating, incised or contused; but if there be any difference, Larrey thinks the detaching of the eschar, especially if the stump be exposed to cold, is the most critical period. It is singular, however, that time destroys the predisposition given by the wound; for Sir James Macgrigor gives as the result of his great experience, that no person is attacked with tetanus after the 22nd day from receiving the wound, a period which Sir Gilbert Blane extends to the fourth week.

Elementary Principles of Medicine.

All ages are liable to this disease, and even new-born children suffer from it, the "trismus nascentium" being ascribed to the tying of the navel-string. Tumbling boys are also frequently seized with this complaint. It is most common, however, in adult age; and if less frequent in old age, this circumstance is probably owing to persons in advanced life being little exposed to those accidents which usually produce it. Both sexes suffer from it; but men far more commonly than women. The ratio that died in 1839 was 102 men to 20 women.

Pathology.—The body has often been most minutely examined, after the patient has fallen from idiopathic tetanus, without any lesion being discovered; and when he has sunk from traumatic tetanus, nothing has been found in many instances, except, perhaps, the primary superficial wound. In a few cases the membranes of the brain have been found congested; but not in a greater degree than might have been predicated from the violent and long-continued muscular action incident to the disease. In a smaller number of instances small patches of cartilages or of bony matter have been found on the spinal arachnoid membrane; but as these are often absent, they are not essential conditions of the disease. It seems proved, therefore, that tetanus is a disease of function; and, as Majendie has shown, if the spinal cord of a living animal be divided into as many segments as there are vertebræ, that the animal, if poisoned with strychnine, still becomes tetanic, although all direct connexion of the muscles with the brain is destroyed; it seems probable that the cord, as high as the fifth pair, and not the brain, must be the great seat of this affection.

Symptoms.—There are five varieties of tetanus—or trismus, tetanos, emprosthotonos, opisthotonos, and pleurosthotonos; and when either of these diseases terminates within eight days, it is said to be acute; but if prolonged beyond that time it is termed chronic.

Trismus is that state in which the disease is limited to the muscles of the lower jaw and throat. Tetanos is marked by the flexor and extensor muscles of the body generally being equally and strongly contracted, keeping the whole frame in such a state of tension that if you attempt to raise the leg, you, according to Baron Larrey, raise the whole body, it being as inflexible as in death. Emprosthotonos is when the flexor muscles bend the body forwards. Opisthotonos when they bend the body backwards; and pleurosthotonos is when they bend it laterally, or on one side only.

The frequency of occurrence of these different forms of tetanus is not accurately determined; but trismus is the most common: and though it may exist *per se*, it is generally the first and concomitant symptoms of all the other forms. After trismus, opisthotonos is far the most common, both in this country and throughout Europe; but Baron Larrey says that emprosthotonos was most common in Egypt. Of pleurosthotonos only a very small number of cases are to be found recorded in the whole annals of medicine.

The attack of either form of tetanus may be sudden; but more frequently it is preceded by an uneasy sensation and tension of the præcordia, followed by stiffness

of the neck, shoulders, and lower jaw. At length the patient feels a sudden and painful traction of the ensiform cartilage; and this latter symptom is considered the pathognomic sign of the disease. Shortly after this the jaw becomes locked, and cannot be opened even to admit the little finger. At this point the disease may stop, and the phenomena be limited to trismus; but more commonly the patient takes to his bed, and the disease assumes one of its severe forms, as of opisthotonos, emprosthotonos, pleurosthotonos, or of tetanus.

In opisthotonos, in addition to the trismus, the muscles of the face are generally spasmodically affected, for the brow is knit, the corners of the mouth are drawn, giving to the patient a most wretched grin, or the risus sardonicus. The eyes also are almost motionless and sunk in the socket; and, during the attack, the tongue is projected against the teeth, so, except for the trismus, it might he caught by a convulsive snapping of the jaws, and severely injured. The characteristic of this form of the disease, however, is, that the flexors of the back are thrown into such powerful action that the spine becomes arched, and sometimes to such a degree that the body rests on the occiput and heels, as on the extreme points of the segment of a circle. The flexors of the back, however, are not the only muscles affected, for the shoulders are thrust forward by a strong action of the pectoral muscles, while the extremities are elongated and tightly braced by strong contractions both of their flexors and extensors. Indeed, the whole of these different sets of muscles are thrown into action at the same moment, as if by the discharge of a powerful galvanic battery. The shock is transitory; and, having passed off, an interval succeeds which varies from a few minutes to half an hour, an hour, two hours, or longer, according to the severity of the disease. But during this interval the patient lies as in his coffin, with his arms close to his sides, and his legs stretched out and touching each other, fearing lest the slightest motion should produce a recurrence of the attack. His nights, or such few as he lives through, are sleepless, or only marked by a few minutes broken slumber. Such is an attack of opisthotonos. The other forms of the disease differ only by the different sets of muscles affected.

It is difficult to give an idea of the distressing violence of the spasms; but they may be imagined when it is stated that Desportes gives a case in which both thighs were broken. But notwithstanding this strongly powerful action of the muscles, the patient's mind is seldom affected, and his pulse presents its healthy beat, only a little accelerated. The intercostal muscles partaking in the general spasm, the respiration is carried on principally by the diaphragm; and, when the attacks are frequent, the breathing is short and laborious. The skin is, after a short time, covered with a profuse sweat, as during great exertion. The tongue is clean and moist; but the bowels are generally constipated, and the sphincter ani so contracted, that it is difficult to introduce a glyster-pipe. In cases in which tetanus supervenes on a suppurating wound, the sore dries up and is painful, while the muscles of the part are highly irritable.

In mild cases the paroxysm returns only three or four times in the twenty-four hours; while in severe cases it returns not only every hour or every quarter of an hour, but every motion of the body or attempt to open the mouth is followed by an attack. In the last stage the situation of the patient is most pitiable, the spasm returning every few minutes, till he is at last cut off by one of unusual violence.

The duration of this disease is very various; in some instances death occurs in twenty-four hours; more commonly on the second, third, and fourth day, and, when fatal, is seldom protracted beyond the eighth. Some few persons survive till the seventeenth or twentieth day; and in this case the disease generally terminates in recovery.

Diagnosis.—The jaw is sometimes locked by enlargement of the cervical glands, and also in some forms of hysteria. The tumor, however, in the one case, and the hysteric passion in the other, are circumstances which readily enable us to distinguish them from trismus. The formidable phenomena of tetanus is seen in no other disorder except cholera; but the other differences between the two diseases are so extremely marked, that it is impossible not to distinguish them.

Prognosis.—The prognosis in this disease is always most grave. In the Peninsular war, although hundreds of cases were treated in every different manner, yet few, very few survived. In civil life the chances are something more favourable; and if the accident be of little moment, and the patient very young, he sometimes recovers. Dr. Parry thinks, if the pulse be not more than 100 or 110 up to the fourth or fifth day, the patient almost always recovers. The danger decreases in general also in proportion to the duration of the disease, for few patients die after the fourteenth day. The danger in the early stages is to be estimated by the frequency and violence of the paroxysm.

Treatment.—Baron Larrey affirms that this disease, if left to nature, is quickly fatal.

One of the most remarkable features of this complaint is the insensibility of the brain and nervous system generally to the action of our most powerful remedies; so that they are not merely inefficacious, but almost inert. Sir James Macgrigor says that all the most powerful remedies were fully tried in the Peninsular war; and that little or no dependence could be placed on any of them. Opium was largely tried after the battle of Albuera, and given in the enormous dose of twenty grains every three hours; and yet it not only failed in curing the disease, but did not even produce sleep. Mercury was tried after the battle of Salamanca, and to such a degree, that strong mercurial ointment was rubbed in three times a-day in unlimited quantity, yet it entirely failed. One man, strongly under the influence of mercury, was seized with tetanus and died. While Baron Larrey's experience in Egypt led him to believe that mercurial frictions only aggravated the disease. Opium and mercury were then combined; but, according to Sir James Macgrigor, the combination was as inefficacious as their separate exhibition. Wine and brandy were used in unlimited quantity; but without producing intoxication, or mitigating the symptoms. Many other stimulants, as musk, æther, camphor, were afterwards employed, but equally without success. Venæsection had also a fair trial in several quarters, and in a great number of cases; but only one man recovered. Tobacco glysters are not only not serviceable, but have been sometimes followed by the instant death of the patient. Digitalis has equally disappointed the hope which had been entertained of it; and one man is said to have died under its depressing influence. Prussic acid has also been tried and failed. Dr. Elliotson speaks in high terms of the carbonate of iron; and he

has given it to the extent of 2 lbs. in the twenty-four hours; and under this treatment two out of three cases recovered. The instances, however, are far too few to enable us to decide on the value of this medicine, especially as a very long period has elapsed without any confirmatory evidence. The warm bath has been thought serviceable in some cases; but patients have died while immersed in it. The cold bath is worse than useless; it is dangerous. Baron Larrey speaks of a patient who had twice gone into the cold bath, but with so little benefit that he absolutely refused to encounter a third. A blanket, however, was thrown over his head, and he was then plunged into the water. He died a few hours after, when it was discovered he had ruptured the sterno-pubian muscle in all its thickness. Dr. Elliotson speaks of a case in which the patient was taken out of bed and placed in a tub in the middle of the ward, when a pail or two of water was dashed over him. The man fell down dead as if he were shot.

It appears, then, that all the heroic modes of treatment medicine offers have been tried and failed. Much good, however, is gained by attempting to restore, especially in idiopathic tetanos, the secretions to a healthy state; also by supporting the patient, and by endeavouring to tranquillize the high irritation under which he is labouring. In St. Thomas's and in St. Bartholomew's Hospitals several cases have been restored by this means. The medicines employed were moderate doses of purgative medicines, with tinct. opii ♏ v., or its equivalent, 10 grains of Dover's powder, given every three or four hours; and these were conjoined with moderate quantities of wine, sago, or other nutritious diet. Musk also, in ten-grain doses, has been given with some advantage.

Some authors lay much stress on a local treatment in traumatic tetanus. Baron Larrey, as the result of his great experience, says, "When it is caused by the wound, we should not hesitate to operate on the first symptom of tetanus, and thus, as far as possible, remove the causes of irritation. If tetanus follows amputation, &c., he recommends the stump to be sprinkled with powdered cantharides; and in cases where a nerve has been included in the ligature, that the ligature be removed either by section, or by actual cautery. In the British army, however, all these proceedings have been adopted, and with very little success, for amputation has been frequently performed without any mitigation of the symptoms. The wound has also been excised, submitted to actual cautery, been blistered, and dressed with every ointment; but in general the disease has run its course, either uninfluenced, or else its fatal termination has been accelerated. Hennen has even seen the wound heal and the patient die on the same day. Nothing, in fact, is so unsatisfactory as the results yet obtained from either the general or local treatment of this fatal affection. Larrey has often attempted, from the difficulty of swallowing fluids that sometimes attends this complaint, to pass an elastic tube; but in all cases he says he met with a contracted state of the œsophagus impossible to overcome; while the attempt was constantly followed by the immediate occurrence of the severest spasmodic attacks.

Neuralgia.

Besides the functional diseases that have been mentioned of the brain and cord, the nerves they give origin to are likewise often the seat of functional disease. Thus the nerves of sensation are frequently the seat of excruciating pain, ever returning, and this affection is termed Neuralgia. If from any cause the sensation of a part is dull, benumbed, or entirely lost, the disease is termed Anæsthesia. On the contrary, if there be an entire loss of motion in a part, the disease is termed Paralysis; or, if the action of the part be irregular and violent, it is termed Spasm or Cramp.

Of Neuralgia or Tic Douloureux.

This disease of the nerves was known to Galen; but the more complete development of this branch of medicine is of modern date, and is owing very principally to the labours of Parry and Jenner, of Chaussière, of Sir Charles Bell and Mr. Mayo. No death is reported of this disease in England and Wales in 1839.

Remote Cause.—The remote causes of this class of affections are extremely undetermined, but they are supposed to be extremes of heat or cold—or sudden changes from the one to the other. It is also often a result of impaired general health. Thus women after profuse menorrhagia, or after child-birth, or persons recovering from fever or other severe disease, often suffer from neuralgic affections. Arsenic also appears to be a cause; at least persons who have attempted to poison themselves with that mineral often suffer agonizing pains in the limbs. Blows or wounds, or the pressure of an aneurismal or other tumor, sometimes seated in the nerve itself, are also causes of neuralgia.

Predisposing Causes.—Of 123 cases observed or collected by M. Chaponière, only two cases occurred in children under ten years of age. Tic douloureux seldom therefore occurs before puberty. An equal number is supposed to occur in each ten years of the period between twenty and sixty, showing the great tendency to increase with age. As to sex, this disease is more common in men than in women; and in women it occurs rather more frequently before thirty than afterwards, especially in those whose menstruation is irregular either as to time or quantity. The place of abode, manner of living, trade or profession, and as far as has been traced, hereditary predisposition, have little influence on the production of the disease.

Pathology.— Sir Charles Bell and Majendie have carefully examined the affected nerves after death in neuralgia and found them healthy. In some few instances, some morbid appearances have been observed, but only such as are probably accidental, or the consequences of the disease itself, as redness or atrophy of the nerve. On examining the head of the late Dr. Pemberton, for example, there was found an unusual thickness of the os frontis, and also a little ossific deposition in the falciform process. In another case, also, Sir Henry Halford has observed a similar thickening of the frontal, ethmoidal, and sphenoidal bones. But osseous formations in the dura mater, and also thickening of the bones of the cranium, are often met with without any symptoms of tic douloureux. Painful affections of the nerves have also occasionally occurred in consequence of cancer or other diseased structure of the brain, but not necessarily so. The labours of the anatomist have therefore thrown little light on this affection, and consequently the essential nature of neuralgia is merely a disordered function of the nerve.

Symptoms. — All authors have observed that the most superficial nerves are those which are principally if not solely affected with this disease; and of those nerves the following are the most frequently so:—

Elementary Principles of Medicine.

Numbers attacked.		Systems of Nerves.	Particular Seat.
Men.	Women.		
124	142	Trifacial nerve.	Supra-orbitary nerve. Infra-orbitary. Inferior maxillary. Nasal } rare. Temporal }
9	9	Cervico-occipital.	Occipital. Mastoidean.
		Brachial.	Cubital. Musculo-cutanei. Radial. Median: very rare.
	Women in large numbers.	Dorso-intercostales.	Dorsal. Intercostal.
		Lumbo-abdominalis.	Lumbar. Ilio-scrotal.
		Crural.	Tibial.
75	52	Femoro-popliteal	Femoro-popliteal. Peroneal nerve. External plantar nerve. Internal plantar nerve.

The symptoms of tic douloureux are similar, whatever be the nerve affected; it is therefore proposed only to treat of those of the trifacial, as being the more usual seat of this trying complaint.

The most common seat of tic douloureux is the fifth pair of nerves, or the nerves which give sensation to the face; and the frequency with which its different branches are attacked is in the following order. The infra-orbital or pes anserinus, the supra-orbital, and lastly, the inferior maxillary nerve. These branches may be attacked separately or conjointly; most commonly, however, only one branch is affected, less frequently two, and the case must be severe in which the three branches or the whole side of the face is affected.

The attack of this disease is sometimes sudden, but more generally it is preceded by a dull aching pain at the points where the nerve issues from the cranium or becomes superficial. After this threatening symptom has lasted a few hours or a few days, the patient is seized with a violent darting or shooting pain in the course of the nerve, returning at intervals, and which is the characteristic of the disease. The paroxym is short, lasting only a few seconds or a few minutes, but the pain is perhaps the most severe that the human frame is capable of suffering. Some patients have compared it to an electric shock of great intensity, others to the conflagration of gunpowder, and others to the intensity and violence of a fulminating powder. The late Dr. Pemberton was known to have stamped the bottom of his carriage out during the paroxysm; and Valleix mentions a physician who, suffering from this disease, was induced, by excessive agony, to make deep incisions into his face, and then to apply actual cautery to the wounds; but his pain not being mitigated by these methods, he several times attempted suicide. Even in mild cases, the patient often on the instant of attack becomes fixed like a statue, fearing to move a muscle or a limb lest he should aggravate the pain or reproduce the seizure.

In cases of ordinary intensity the effect is so completely limited to the nerve that even the skin is not discoloured, while the organs immediately in connexion with it are little affected, the eye perhaps being only watery, the nose hot, and the teeth aching. In severer cases, however, and where the disease affects the nerve generally, the condition of the patient is most lamentable. The mouth is spasmodically drawn as in palsy, so that the saliva flows over the chin and neck. That fluid also is increased in quantity and altered in quality; for in cases in which the patient is afraid to clean his teeth lest the paroxym should return, the whole of the teeth of the lower jaw have become so incrusted with tartar as to form one solid mass. The eye and eyelid are likewise frequently convulsed, the conjunctiva injected, the nose discharges a muciform matter, the very hair of the head is painful, and the affected nerve may be traced by a red line marking its course.

The recurrence of the paroxysm is very various: in slight cases it may return only once in a few weeks, or in a few days; but in severe cases it will return every quarter of an hour, every five minutes, or every minute, and even every few seconds. In a few cases (ten out of forty-six) the paroxysms occurred periodically and at stated intervals. Yet in general the times of recurrence are very uncertain, sometimes the patient being attacked with great violence many times a day for many days or weeks together, so that the disease is almost continued; and then it intermits for a week, a month, six months, or a year.

It has been imagined by Bellingeri that the attack usually takes place before the middle of the day, but this rule is liable to many exceptions, for it often occurs in the night as well as at all times of the day. The disease is situated nearly as often on the right as on the left side of the face, or, according to Valleix, twenty-three times on the right and twenty-one times on the left, and only twice on both sides of the face. Pressure over the diseased nerve rarely increased the pain, or only in three cases out of twenty-one.

The total duration of the disease is very various. In some cases it terminates after a few paroxysms, in others it lasts from one to six months, and in some cases it becomes chronic and lasts the whole period of a long life. It seldom disappears suddenly, but oscillates with a decreasing intensity; the intervals gradually becoming lengthened till at last the disease subsides.

Diagnosis.—The disease to which neuralgia bears most resemblance is rheumatism, but it is distinguished from it by the transitory nature of the attack and by the absence of all swelling. Valleix gives also as a diagnostic symptom, that there are certain points which, being pressed in the interval of the paroxysm, give pain. These points are four-fold, or 1st, Where the nerve emerges from the bone, as at the supra-infra-orbitary, and mental foramina, in trifacial neuralgia. 2ndly. Where the nerve, passing through muscles, reaches the skin. 3rdly. Where the nerve terminates in the skin; and lastly, where the nerve becomes very superficial, as the cubital and peroneal nerves.

Prognosis.—This disease has very rarely terminated in death, and in general the patient's health is good throughout its whole course.

Treatment. — Almost every practitioner has some specific mode of treatment for this disease. The late Dr. Baillie recommended sarsaparilla,—Mr. Hutchinson the sulphate of iron, — Dr. Elliotson the carbonate of iron, — others have greatly praised arsenic, — others mercury, or the disulphate of quina. Bleeding, either local or general, has had its advocates, while its opponents affirm this operation to be always useless and sometimes injurious. There can be no question that

the disease has often subsided under the use of all these various remedies; but the tendency in neuralgia to a spontaneous intermission is so great, it is doubtful whether in any case they can be said to have cured it. Opiates are unquestionably serviceable in mitigating the sufferings of the patient, and perhaps in influencing the disease, but not to the extent generally supposed. "Belladonna, both internally and as a plaster, will relieve the pain; and some persons," says Dr. Elliotson (note, p. 507), "have *said* they have seen it cured by it. Stramonium and opium have a similar effect; but in general you may give these things till you induce vertigo and apoplexy, and yet the pain will get no better. Belladonna and perhaps stramonium are better than opium, and they appear to have done occasionally good."

When these or other general remedies have proved insufficient, recourse has been had to local remedies. The most efficient of these applications is supposed to be the ungentum aconitinæ, or else an ointment of morphia, and likewise blisters, and the disease has often subsided under their use. Steaming the head, and the warm bath, are equally or even more beneficial. The belladonna plaster is a most favourite application.

When general and local applications are unsuccessful, the cause is often sought in a diseased tooth or stump, and in a *very few* instances an exostosis of the stump has been discovered and the disease cured. More commonly, however, even when the patient submits to have every tooth in his head drawn, no relief or benefit has resulted.

Besides extracting the teeth, a last resource is, dividing the nerve; but even this operation is very uncertain. Complete division of the nerve, with excision of a portion of it, so as to prevent union by the first intention, has been practised over and over again, but with only temporary benefit. The division of the nerve also has this disadvantage, that when most successful it is often followed by numbness and loss of power of the part affected, but the more distressing circumstance is, that the neuralgia has so frequently returned that few surgeons are now inclined to operate for the disease. In some few instances, when the neuralgia has been the result of a puncture, the removal of the cicatrix has cured the patient; but there are many exceptions to the success even of this operation.

Anæsthesia, or Palsy of the Nerves of Sensation.

An excess of sensibility of the nerves is the characteristic of neuralgia, but the nerves of sensation may suffer from a directly opposite state, or from a defect of sensibility—a numbness or a complete loss of sensation. The cutaneous nerves are those most usually affected, and from this cause the disease most usually attacks the integuments of a portion of the trunk, or of an arm, or a leg, or some given portion of the extremities, and also the whole face or parts of the face, indicating an affection of the fifth pair.

As the remote and predisposing causes of this disease, as also its seat, are similar to those of neuralgia, so its pathology, likewise, is equally negative, or with no other peculiarity than being more frequently connected with disease of the brain. As the symptoms, moreover, are so marked that it is impossible to mistake them, it seems unnecessary to do more than to point out two remarkable laws incident to this form of the disease. The first is, that parts do not waste in anæsthesia as in muscular palsy, which is singular, for the nerves of sensation and of motion, with the exception of the fifth pair, appear throughout the body to be inseparably connected and contained in the same sheath. The second law is, that in anæsthesia, the nerve affected, though insensible as to touch, still remains sensible to changes of temperature. The treatment of anæsthesia, unless the disease be connected with the brain or spinal cord, principally resolves itself into attention to the general health.

The diseases of the nerves of motion are—*Paralysis, Paralysis Agitans, and Spasm.*

Of Paralysis of the Nerves of Motion.

Palsy of a part is a very constant symptom of structural disease of the brain or of the spinal cord, but it occasionally happens from mere diseased function of the nerve itself. Palsy, from this cause, may affect a finger, a hand, an arm, or a leg; but its most frequent seat is the seventh pair or facial nerve. Two cases of this kind were recently admitted into St. Thomas's Hospital, in which the brow was motionless, the mouth drawn, and with the eye red from inability to close the lid. In severer cases, the lower eyelid is everted and the tears flow over the cheek. The eye, if the disease be prolonged, inflames either from its constant exposure to light, or from the presence of other irritating causes removed in health by the action of the eyelids. The eye, also, is sometimes turned outwards from palsy of the third pair, and sometimes inwards from a similar affection of the external motor of the eye. When the third pair is palsied, the upper eyelid, to which it sends branches, often falls down, covering the eye entirely, and is so completely powerless that it cannot be raised except by the hand; and this state is termed *ptosis.* Sometimes the nostril, also, is motionless and flattened. This disease arises from cold damp weather, mechanical violence, or other general cause. It seldom occurs till adult age. No further pathological phenomena or symptoms attend it. The treatment is by blisters behind the ear, and by attention to the general health.

Paralysis Agitans is a minor affection of this class, and consists of a feeble trembling action of the muscles, not amounting to palsy. The nervous fluid is consequently not altogether wanting, but is deficient in quantity, and exhausted by the slightest action of the muscles, as in old persons. This disease is met with most commonly among gilders and silverers of looking-glasses, and the class of persons who work with mercury. It is also frequent in the drunkard, in the aged, and in persons who have suffered from cerebral or spinal structural affections; it consequently seldom attacks young persons, but is most usual between the ages of 40 and 60. The bodies of those who have fallen from this disease have been examined; but, except in those cases in which it has depended on cerebral or spinal lesions, no pathological phenomena have been found. This muscular weakness may be general or partial. When general, almost every fibre quivers, so that to raise any liquid to the mouth without spilling it is impossible; and if the patient attempts to walk, he steps short and quick, treads on his own toes, and is almost obliged to run to keep himself from falling. When the disease is partial, the head often shakes like that of a Chinese mandarin, or one hand or arm may be in incessant motion. In one case lately, in St. Thomas's Hospital, the patient, a man about 30,

beat the devil's tatoo with his left leg, whether sleeping or awake, for many weeks, to the great annoyance of the whole ward.

Paralysis agitans is a very obstinate disease; and Dr. Elliotson does but speak the sense of the profession when he says, "I have not been by any means successful in the treatment of this disease. I believe, when it occurs in old people (when the hand shakes, or the head), you can do no good; at least, I have never known good done. Where it has occurred pretty universally, I have never been able to cure but one case, and in that instance the patient was not old; he was not above 35 years of age. After using other remedies unsuccessfully, I then exhibited sub-carbonate of iron, under the employment of which he became pretty well, and remained so for some time afterwards. I have since had four or five other cases under my care, and have exhibited the same medicine, but it has not produced the least benefit."

Spasm—Cramp.

Many persons are habitually subject to a spasmodic action, or tic, of some one muscle of the face. When the contraction, however, of the affected muscle is attended with pain, it is termed *cramp*. Many persons, and of all ages and of both sexes, are greatly subject to cramp; and the parts it most commonly affects are the arms or legs, or the abdominal muscles, and especially the rectus. It is most commonly excited by cold; and, from this circumstance, so many young persons are drowned, seized with cramp while swimming. It also often occurs during sleep, and while the patient is warm in bed. It is produced, also, by causes which greatly exhaust the nervous power. Thus, women are often seized, either immediately after or during parturition; it also often occurs in the course of a severe diarrhœa. No pathological lesion attends this affection. The symptoms are manifest. The return of the attack, in ordinary cases, is extremely uncertain, and so is its duration when present. It seldom, however, lasts more than a few minutes, though occasionally its duration is much longer. The treatment of this affection appears to be, first to rub the part, and then to apply warmth when it is caused by cold, and cold when it is caused by warmth, and to throw the whole weight of the body on the leg or other affected part, so as to overcome the spasmodic action of the muscles. If the disease be distressingly frequent, the treatment consists of baths, friction either with the flesh-brush or else some stimulating liniment containing an opiate, and also by attention to the general health.

Of the Neuroses of the Alimentary Canal.

The importance of healthy digestion, and consequently of a healthy state of the digestive organs, for the preparation of our food, has been acknowledged by all writers; and, indeed, Mr. Hunter, on this account, appears to have considered the stomach as the great centre of animal life. The diseases, however, of this system are numerous, and have employed the pens of an endless number of writers; and by none have they been better treated than by those of our own times, as Philip, Prout, Abercrombie, Mayo, and Johnson.

Remote Causes.—The remote causes of these affections are very multifarious, and may be divided into *general* and *specific.* The general causes are errors in the quantity, quality, or temperature of our diet. Atmospheric vicissitudes, the play of the passions, and chemical or mechanical injuries. The specific causes are perhaps endless; but there are four of more importance than the rest,—alcohol (however combined, whether with beer, wine, or drank as spirits), lead, salted provisions, and some fish poisons; and of these it is proposed to treat at some length. In addition to these general and specific causes, we may perhaps, without impropriety, add intestinal worms, calcareous, biliary, as well as certain organic intestinal concretions.

Predisposing Causes.—The present state of the constitution greatly influences the functions of the alimentary canal, for there exists that sympathy between it and every other part of the body that the one is seldom disordered but the other immediately suffers. Almost every disease, therefore, whether an ulcer of the leg, an eruption of the skin, an abscess of the liver, or a headache very constantly, deranges or destroys the healthy functions of digestion.

Age has also much influence, as a predisposing cause, over this class of disease. The infant cannot live on the food which nourishes the child, the child on the diet of the adult; and again, in old age, we can hardly masticate or digest with facility the diet of our early years. Each age has therefore its appropriate nourishment; but slight errors are felt much more seriously in the extremes of life than at its adult and middle portion. The *habits* of life affect the powers of digestion almost as much as age, for the hardy countryman often lives on food which would destroy the effeminate townsman. *Sex* has also much influence in producing disordered states of the digestive organs. The female eats, perhaps, oftener than the male, but her appetite is more delicate, and her sedentary habits are unfavourable to digestion. Having thus briefly mentioned the *causes*, generally, of the neuroses of the alimentary canal, it will now be necessary to speak of its particular disorders, and of their particular causes; and first, of Dysphagia.

Dysphagia.—The œsophagus is a fibrous canal by which the food descends from the mouth into the stomach, and is sometimes so irritable and sometimes so completely void of power, so palsied, that it opposes an obstacle to the introduction of either solid or liquid food into the stomach; and this difficulty of swallowing is termed dysphagia.

The causes producing difficult deglutition are in general connected with some previous state of ill health, as phthisis. It is not uncommonly a consequence of mental affections, as of hysteria or insanity, the latter class of persons often falling from a sudden palsy of the œsophagus, so that the food being retarded in its passage at the root of the tongue, makes its way into the larynx. A case of dysphagia is now in St. Thomas's, caused by a bony enlargement of the thyroid gland; and any other tumor, external or internal, pressing on the œsophagus, will equally produce a similar result. It will only be in our power to give an example or two of this affection.

A woman was admitted into one of the large hospitals in London, complaining of an entire impossibility of passing anything into her stomach, and that whatever she attempted to swallow was immediately returned. A probang was passed, and as it was stopped before it reached the stomach it was supposed she was labouring under cancer of the œsophagus; an opinion which was the more strongly confirmed, as she became daily more

and more emaciated. At length, however, at the end of many days, she made an effort to vomit, and threw up a piece of beef of considerable size, and which she now remembered she was eating when first seized. She entirely recovered; and consequently a permanent spasm of the œsophagus must have existed in this person for a great many days.

Mr. Hunter gives a case of palsy of the muscles of deglutition so complete that the patient was obliged to be supported by nourishment injected into the stomach by means of an elastic tube. She, however, recovered, and, as Mr. Hunter imagined, by taking a drachm of valerian and two scruples of flour of mustard daily. Pinel gives a case of one of the nurses of Salpêtrière, aged sixty, who laboured for six months under a violent dysphagia; and Hoffman describes also a similar case. It is remarkable that both these cases were cured by accident; for Pinel had ordered a drachm of camphor to be rubbed up with olive oil and used as a liniment, when by mistake the woman took the entire quantity in the course of the night; while Hoffman had ordered for his case half a drachm of camphor to be rubbed up in the same manner, and to be taken in divided doses; but the woman took the whole quantity at one draught.

The *Neuroses* of the stomach, from general causes, may be divided into those which, as far as we know, are unaccompanied by any morbid secretion, and into those in which the secretions are vitiated; although it must be admitted the two forms of disease often co-exist. The former, however, embraces gastralgia, emesis, ruminatio, pica, bulimia, abstinentia, and polydipsia. The latter includes cardialgia, pyrosis, cholera vulgaris, and pneumatosis.

Gastralgia, or stomach *Colic*, is a severe pain in the stomach, often so completely idiopathic that the slightest cause produces it. One person cannot eat a strawberry, another a gooseberry, another an egg, without being seized with it. In other cases, every sort of diet produces it, so that the patient is racked with pain after every meal. The parties affected are usually adults; and women are more frequently the subject of it than men.

The attack of *colic* is generally sudden, and the patient unexpectedly seized with a pain in the stomach, which attains its greatest height on the instant. This pain is so violent that it either bends him double, causes him to roll on the floor, or else to lie flat on his belly, making strong pressure on the abdomen, and which pressure he fortunately finds gives him relief. This attack is generally accompanied by sickness or vomiting, by great flatulence, and by a confined or purged state of the bowels. It may last from a few minutes to a few hours, and often ceases as soon as the stomach is emptied or the bowels have acted; but when the patient is costive, it very constantly continues till he is relieved by medicine, when it subsides almost as rapidly as it commenced, leaving however a soreness behind it. The pulse, in this affection, is natural; there is no fever, and the pain is relieved on pressure; circumstances which readily distinguish it from inflammation. The disease may subside after one attack; but genuine gastralgia sometimes lasts for many months, as in the following case:—

Barras, author of the "Traité sur les Gastralgies," was subject to neuralgia of the face and spermatic cord, when he was one day seized, two or three hours after eating, with a pain in the stomach, as if that viscus was compressed in a vice; he also felt much nausea. These symptoms having lasted for some time, ceased with the eructation of a great quantity of wind. Similar attacks recurred at short intervals, during some months, and were so intolerable that he became emaciated, hypochondriacal, and disgusted with life. He applied a great number of leeches to the epigastrium, and took a great variety of medicines without relief, but was at last cured by the shock caused by the death of his daughter. The treatment of this disease is by mild opiates and gentle cathartics.

Besides being the seat of most severe pain, the nerves of the stomach may be morbidly sensible as to the quality of things eaten, as in pica; or as to the quantity of food, as in bulimia, polydipsia, and in anorexia.

*Pica** is a depravation of appetite, so that the patient desires to eat substances more or less unnatural; or, as it is usually termed, has "a longing." The causes of this affection are not determined; but the parties usually affected are pregnant women, the insane, and chlorotic persons of both sexes. The appetite, in these cases, is extremely capricious, being sometimes entirely wanting, and then voracious, but only for particular substances. The objects of desire, in this disease, are very various, as cinders, spiders, lice, flies, insects, toads, wood, hair, paper, earth, clay, chalk, vinegar, and even fæcal matters. Our medical records abound with cases of the following kind:—Dr. Elliotson met with a lady who fancied brown paper; "not paper hot-pressed and gilt-edged, but brown paper." Dr. Copland gives the case of a man who occasionally delighted to indulge himself in devouring a whole wine or ale glass, crumbling it between his teeth. A child, affected with epileptic fits, eagerly swallowed skeins of silk, reels of thread or cotton, needle-cases, buttons, or whatever came in his way that he could force down his throat; at length, nothing else being to be found, he ate the outer shell of the walnut, till his mouth and throat became painfully sore, swollen, and excoriated. In every mad-house there are young women fond of fæcal matter, who require to be watched every time they go to the water-closet. The longings of pregnant women are notorious. One longed for red-herrings, and actually ate 1400 of them between conception and parturition; another longed for a bite of a butcher's shoulder, and another for a bit of a priest's sleeve; but there is no end of these capricci.

Perhaps the most remarkable instance of pica is the irresistible propensity which the inhabitants of some countries of the torrid zone have to earth-eating. In Guinea the negroes eat a yellowish earth, called cavuac. Humboldt, on his return from the Rio Negro, fell in with a tribe of Ottomacs, who lived, during the rainy season, principally on a fat unctuous clay, each individual consuming from three-fourths to four-fifths of a pound daily; and in the dry season they usually ate a small portion as a relish. In Japan, cakes of reddish earth, called tanaampoo, are exposed for sale, and bought by the women to improve their beauty, slenderness of form being esteemed among the Japanese. In the West Indies, dirt-eaters, as they are termed, acquire a stronger attachment for a white clay, like tobacco-pipe clay, than either for spirits or tobacco. Their delight is to fill their mouths with it and allow it to dissolve; a practice which extends to negroes of all

* From pica, a pie; a bird said to be liable to this complaint.

Elementary Principles of Medicine.

ages, for even children acquire it almost as soon as they leave the breast. Dr. Hunter states that a negro labouring under this malady is considered as irrecoverably lost for any very useful purpose, and that he seldom lives long. The treatment of this affection is attention to the general health, and the exercise of moral influence.

Bulimia is a most inordinate appetite, entirely disproportioned to the wants of the body. The French have divided this form of disease into *faim de loup*, and into *faim canine*, the latter being distinguished from the former by the gorged stomach relieving itself after every meal by vomiting. Either form of this disease is extremely rare, and its causes unknown, but it generally occurs in the lowest class of persons. When Bonaparte was first consul, he sent to Corvisart a Russian soldier labouring under the *faim de loup*, and to whom it was equally indifferent what he ate, but he required every day forty pounds of meat and bread, or its equivalent, two bushels of potatoes. He daily drank, also, fluids to the amount of twenty-five pints. Leroux gives an account of a man named Bogén, the keeper of wild beasts in the Jardin du Roi, who had a similarly enormous appetite, and to whom it was equally indifferent what kind of animal he ate, whether it was fresh or putrid, killed in a state of health or had died of disease, raw or cooked. He is said to have eaten up a rhinoceros, an elephant, and several lions and tigers. He at length fell ill, and was brought to La Charité, where he not only ate up all that remained of the patients' food; but Leroux even saw him devour the poultices as they were taken off their sores. The patients who have died of this disease have been found to have singularly enlarged stomachs, hanging down like a pouch. They seldom live long or enjoy good health.

Several cases of the *faim canine* are given in the "Philosophical Transactions." One, a boy that lived at Blane Barnesley, in Yorkshire, and only twelve years old, who devoured 384 lb. of solid and liquid food in six days; but after every meal he vomited. In another similar case, 371 lbs. were eaten in the same short space of time, but he also vomited so that he was literally starved in the midst of his abundance.

Anorexia is the opposite extreme to bulimia, and is a loss of appetite, accompanied by most feeble powers of digestion. Anorexia occurs to a greater or less extent in almost every case of acute disease; and occasionally also it occurs as a primary disease, and to such a degree as to have acquired for the patient the reputation of the "fasting woman." Among the many instances of this class is the celebrated Anne Moore, the "fasting woman" of Tutbury. This person was fifty-one years of age, and gave out she had not tasted any solid food for five years, nor any liquid for nearly four years, and had no desire for either; that she never wetted her lips but when she washed her face, which happened only once a week; that she had voided no urine since Easter three years, and no fæces since that day five years. She professed also never to sleep so as to forget herself, nor to have lain down in bed for more than three years, although she admitted she sometimes dosed and reclined her head on a pillow. By this remarkable story she obtained great notoriety and much money, and was continuing to practise on the public credulity when it was determined to prove the truth of her assertions by setting a watch over her. The first watch was wanting in closeness of observation, and proved unsatisfactory, but enough had been seen to arouse suspicion. A second watch was therefore proposed, to which she assented most reluctantly. This second watch was superintended by three magistrates, four physicians, twenty-eight surgeons, and fifteen clergymen of the Church of England, who attached a Merlin's weighing-machine to the bed, and took every precaution to detect imposture. Up to the tenth day she did not take any nourishment, but the machine showed a loss of weight of many ounces. She now fell into syncope, from which she was recovered by administering some nutriment, when she confessed she could not exist without some food, as milk or tea, into which her daughter admitted she sometimes put sugar.

Abstinentia, or starvation, is the last degree of anorexia. Some persons fall into this state from cancer or stricture of the œsophagus; some from insanity, and a few others from the ordinary accidents of life. If the party be deprived altogether of fluids, he generally falls in three or four days, or at most within a week. A person, however, will live much longer deprived altogether of solids, provided he is able to obtain fluids.* The longest fast perhaps on record occurred in Dr. Willan's practice, who attended a religious monomaniac who had lived sixty-three days on a pint of water flavoured with a little orange-juice daily. From the histories of these cases it appears that the sensation of hunger ceases about the third day, and that when the fast is much prolonged beyond this period the party becomes querulous and subsequently outrageously mad. When Captain Franklin undertook his perilous journey to the North Pole, his party, during their extreme privations, were sensible of each other's pettishness and irritability, and wondered, if they lived to return to England, "whether they should recover their senses." When the Medusa, a French frigate, was wrecked off the coast of Africa, and the crew had betaken themselves to a raft, they fought battle after battle, throwing each other overboard, and all this without any object. Of the small number saved, one officer had so far lost his senses, that the night he was rescued he attempted to throw himself out of one of the ports of the vessel, to take a walk, as he said, in the green fields.

The pangs of hunger are, in the first instance, merely a neurosis of the nerves of the stomach; but it seems probable that after a time they become the exciting cause of a low inflammation; for we uniformly find, in cases of long inanition, whether from disease or accident, that the mucous membrane of the stomach is of a deep venous red or brown colour, and covered with a glairy mucus. It is this highly congested state which in all probability renders a minimum quantity of the lightest kind of diet, as a few occasional spoonfuls of milk or broth, alone proper in the first few days for the recovery of the famished patient. It is universally observed that any dereliction of this rule is generally fatal.

Polydipsia is an inordinate thirst—a disorder concomitant with many complaints, but which is also sometimes idiopathic. A small tradesman was admitted into the Hôtel Dieu with a sprain of the knee, when his uncommon thirst attracted attention. It was ascertained that he had been affected with polydipsia ever since he was five years old, and that from the time he was sixteen he had never drank less than two buckets a day. While

* In M. Chossat's experiments, rabbits were found to live one-fifth longer when allowed water *ad libitum*.

he remained in the hospital he never drank less than thirty-three pints daily, often swallowing two quarts at a draught; his solid food was about one pound and three-quarters daily. This patient soon recovered from his accident, seemed in good health, possessed the strength of ordinary men of his age, and was the father of several children.

Emesis, or vomiting, has many grades, or from nausea till nothing is retained on the stomach. It is often a consequence of most structural diseases of the alimentary canal, but it is likewise often purely functional. Young children sometimes suffer from it. Patients labouring under phthisis, or severe cough, or under structural disease of the liver or kidney, young women with an irritable uterus, and pregnant women, are more especially afflicted with emesis. Many hysterical women appear to vomit "par habitude." Pinel gives the case of a lady, aged thirty-seven, who, in consequence of some domestic chagrin, forsook the "grand monde," fell into a state of melancholy, and at length was seized with an obstinate and long-continued vomiting, of which she died. The stomach and intestines were perfectly healthy. The treatment of this form of disease is effervescing mixtures, mild cathartics, opiates, and mustard poultices.

Such is a short outline of the simple neuroses of the stomach, unaccompanied by any determined morbid secretion. The treatment of all these forms is extremely difficult, and resolves itself into attention to the general health, and to regulating the bowels by mineral waters, neutral salts, rhubarb, castor oil, opiates, and mild tonics.

The class of neurosis of the alimentary canal, accompanied by some morbid secretion, is composed of cholera vulgaris, cardialgia, pyrosis, and pneumatosis.

Cholera vulgaris is a severe gastralgia, accompanied by vomiting, and very often by purging, but not necessarily so. This disease is most common towards the close of summer and the beginning of autumn, but is by no means confined to that season. Its remote cause is probably, in many cases, some ephemeral atmospheric poison, and perhaps still more commonly a large quantity of autumnal fruit, or of early oysters. All ages are liable to it; infants, children, adults, and aged persons; but men are perhaps more liable to it than women. Many persons have died of it, and, on inspection, no trace of disease has been discovered in any portion of the alimentary canal, or other part of the body.

The symptoms are, that the patient, perhaps having dined or supped heartily, is awoke in the middle of the night with a severe pain in the stomach and bowels, which shortly afterwards is followed by vomiting and purging. In hot climates large quantities of bile are said to pass upwards and downwards, but in this country bile in any quantity is rare. Much more generally the matters vomited are merely the contents of the stomach, half digested, and extremely acid; while the stools, though sometimes dark, as in ordinary diarrhœa, are often white and colourless. This affection lasts from a few hours to a few days, is extremely exhausting, and if neglected has often proved fatal.

In prescribing for cholera vulgaris, we should look to the state of the tongue; and, if it be white and coated, the treatment is by an opiate, effervescing draughts, or mild purgatives. If, on the contrary, the tongue be clean and the bowels purged, the purgative may be omitted, and the treatment trusted to a mild opiate, as the syrup of poppies, or the pulvis cretæ compositus cum opio ℈j. to ʒfs. ex. aq. menthæ pip. 6tis vel 4tis horis. The diet should be slops and light puddings, and the drink perhaps weak brandy and water.

Cardialgia is the secretion of a fluid abnormally acid by the stomach, causing a most unpleasant sensation about the cardiac orifice, and hence termed *heart-burn*. This fluid is often regurgitated into the mouth, has a most disagreeable oily acid taste, and not only sets the teeth on edge, but, expectorated on any carbonated alkali, causes effervescence; and by Dr. Prout is supposed to be principally lactic acid. The effect of this state of the stomach is both present and remote. The present effects are more or less pain in the stomach, accompanied by distressing flatulence, derangement of the bowels, headache, terrifying dreams. The remote effects of this disease are, inducing palpitation, gravel or stone, or else a gouty or rheumatic state of the constitution, or *uric acid diathesis*, for the urine is loaded with the lithates, and the water small in quantity. This state of things, Dr. Prout seems to think, may be caused by an absorption of the acid, the assimilation in the lacteal system being most imperfect.

This disease most commonly occurs in those that live high, eat largely of rich black meats, and drink largely of malt liquors or champaigne, which act as ferments, turn acid, and dispose everything else to undergo the same changes. Some persons, especially those descended from gouty or rheumatic parents, have an idiopathic tendency to this disease, and in these the most opposite substances will produce it, as sub-acid fruits, salt meats, pastry—indeed anything that deranges their enfeebled powers of digestion. Tobacco has a poisonous principle which greatly favours the occurrence of this disease, and many persons suffer after smoking a very few cigars.

The treatment of cardialgia is by alkalies selected according to the state of the patient's bowels. If constipated, the sulphate of magnesia is perhaps the best remedy; on the contrary, if they be natural, the carbonate or bicarbonate of soda or potash is to be preferred: while, if relaxed, some mild opiate should be added to any of these medicines. Many practitioners prefer magnesia, but this is objectionable on account of its tendency to accumulate and concrete in the intestines. This disorder, once removed, is often prevented recurring by a dinner pill, as five grains of rhubarb, or as many grains of the pilulæ aloes comp., or other gentle purgative.

The dietetic treatment is of the utmost importance in these cases; and the quantity of wine or other fermented liquor, and also of animal diet, should be reduced till the disease subsides and the urine is healthy. Soups, tea and coffee, drank, as they usually are, boiling hot, debilitate the coats of the stomach, and tend consequently to produce this affection, and are abandoned by many persons from their so often exciting cardialgia.

Pyrosis (πυροω, to burn).—Water-brash, *fer chaud*, is a painful disorder of the stomach, occurring in paroxysms, and which does not cease till the patient vomits up a limpid colourless fluid like water, to the patient's taste cold and insipid, but which sometimes gives an acid and sometimes an alkaline re-action.

This disease is frequently met with in Scotland and in Ireland; and Linnæus says one-half of the inhabitants of Sweden are liable to it. From the large quantities of spirits drank in those countries, it has been supposed to be caused by their immoderate use. Dr.

Pemberton, however, was convinced, after the minutest investigation, that this opinion was erroneous. "For had the disease arisen from the intemperate use of spirits, we should expect to find it most frequent among men, who are more addicted to immoderate drinking than women. On the contrary, I find," he adds, "that the disorder is more frequent among women than men, in the proportion of five to one. I must remark, moreover, to show how unfounded is the opinion respecting the use of spirituous liquors being the cause of the disease, that the women in the north of Ireland are remarkably temperate in their own country; and again, that the same order of women, when they are brought to this, and contract the pernicious habit of drinking spirits, are free from this complaint." This affection seldom occurs except in those who live upon a low and insufficient diet.

The fit of pyrosis usually comes on in the morning and forenoon, when the stomach is empty. The first symptom is a sense of constriction, as if the stomach was drawn towards the back, while others describe it as a severe and often a burning pain. This gastrodynia, as in fact it is, the patient finds increased by standing or sitting upright, and therefore he seeks relief by bending his body forward and making pressure on the affected part. The attack lasts from a few minutes to the greater part of an hour, when a clear, limpid, tasteless fluid is vomited up, varying in quantity from an ounce to a pint. As soon as this fluid is rejected the pain ceases, and the paroxysm is at an end. The paroxysm may occur three or four times a day, but when there is only one, it usually comes on before ten o'clock in the morning. In addition to the paroxysm, the patient's appetite is generally impaired; he complains of thirst, his bowels are generally constipated, and his person pale and emaciated.

The medical treatment of this affection is extremely simple, and consists in a drachm of the sulphate of magnesia, with fifteen minims of the tinct. hyoscyami three times a day. Many other medicines have been recommended, as the tinct. kino by Dr. Pemberton; but the simple remedy that has been mentioned is so uniformly successful as hardly to require any auxiliary or substitute. The diet should, if possible, consist of some animal food, and be otherwise nourishing.

Pneumatosis.—The stomach and intestines have the property of secreting gases, probably for the purpose of preventing that collapse of those hollow organs which perhaps would otherwise ensue. The gases found in the alimentary canal are oxygen, azote, proto-carburetted hydrogen, carburetted hydrogen, carbonic acid, and sulphuretted hydrogen. The two first are probably derived from the atmosphere, but all the rest are supposed to be secretions. All these gases, except the last, are found in the stomach, small intestines, and colon, but the sulphuretted hydrogen is found only in the colon, and then in extremely minute quantity.

The secretion of these gases is often a disease of much inconvenience, causing not only great distension, but also often much pain, forming *windy colic*, or pneumatosis. It always marks a feeble diathesis, and is a constant accompaniment of asthma and nervous affections of the heart, and also of every hysterical disease. It is one of the alarming symptoms also of typhus, when it causes tympanitis. If it exists idiopathically, it is best met with warm aromatic tinctures and purgatives, as the tinct. cardamomi, the tinct. aurantii, the decoctum aloës comp., rhubarb, and strong waters, as aq. cinnamomi, or the aq. menthæ piperitidis.

Of the Neuroses of the Intestinal Canal.

The principle neuroses of the intestinal canal are enterodynia or colic, ileus, constipation, and diarrhœa.

Enterodynia, *Enteralgia*, *Colica*, or bowel colic, is a painful affection of the lower portions of the abdomen, caused by a violent contraction of the muscular fibre of some portion of the intestinal canal. The remote causes are indigestion, exposure to cold, or other general cause, and the parties liable are of all periods of life, or from infancy to old age. It also attacks either sex.

It is seldom that persons die of colic, but such instances have occurred, and dissection has often shown some portion of the intestines intussuscepted, affording a strong presumption that this affection depends on a spasmodic constriction of some part of the intestinal canal. This view of the case is supported by Mr. Blane, who states that in fatal cases of colic in horses, different portions of the alimentary canal are found strongly contracted, and much oftener of the small than of the large intestines, which also sometimes contain gas. The bladder also appears to participate in the spasm, the urine being either frequently ejected or else suppressed. Colic, therefore, is a spasmodic contraction of the intestines, the muscular fibre being either primarily or else secondarily affected in consequence of a morbid sensibility of the mucous membrane.

Colic is usually sudden in its attack, and the patient consequently, without any previous indisposition, is often unexpectedly seized with a severe fixed pain in some part of the abdomen, but which is relieved on pressure, so that the patient either sits doubled up or else rolls on the ground. In other cases, where much air is secreted, the bowels are greatly distended, and the pain is now compared to a twisting or wringing pain around the navel, accompanied with soreness. The walls of the abdomen also participate in the internal spasm, so that the navel is often drawn in towards the back, or the heads of the rectus exceedingly prominent, resembling so many round balls. The bowels are generally but not always constipated, and the stomach may or may not be irritable. In the latter case it often rejects both food and medicine. The pulse is little altered at the commencement of the attack; but if the paroxysm be prolonged, and the patient exhausted by pain, it may be hurried and frequent. The tongue is generally clean, although sometimes white and coated.

Diagnosis.—This disease is distinguished from inflammation by the pain being relieved on pressure, and by the quiet state of the pulse.

Prognosis is, in every case, favourable.

Treatment.—The treatment of colic is by opiates, stimulants, and purgative medicines. When the bowels are very constipated, five grains of calomel, fifteen grains of jalap, and one grain of opium should be administered immediately, and followed by mist. camphoræ c. magnesiæ sulphatis ʒj. c. tinct. hyoscyami ♏xv. to xx. c. tinct. cardamomi, ʒj. 4^{tis} vel 6^{tis} horis, until stools are obtained. In mild cases a scruple of rhubarb, or half an ounce of castor oil or other mild purgative, combined with a grain of opium, may be substituted for the opium, calomel, and jalap. Some practitioners have doubted the propriety of exhibiting opiates at the onset of the disease, but it is certain a mild purgative, combined with a mild narcotic, as the tinct hyoscyami, or syr. papaveris, will

effect more than a drastic purgative without such combination.

As the disease is sometimes confined to the large intestine, enemata often give immediate relief. Externally, the application of large bags filled with hot chamomile flowers, or of heated sand, or of the stomach-warmer filled with hot water, are useful. The warm bath, fomentations, or a large linseed or mustard poultice over the abdomen, are also highly useful auxiliaries. Some patients are said, when these remedies have failed, to have been benefited by dashing cold water over the lower extremities; but the experiment is hazardous. The diet should, during the attack, be slops, as sago and arrow-root, with a portion of brandy; and for some time after the patient has recovered it should be light, and, perhaps, limited to fish and puddings.

Ileus, *Miserere Mei*, *Volvulus*, is a severe variety of colic, accompanied by vomiting, often so obstinate that the action of the bowel is inverted, and fæcal matter thrown up by the mouth. The patient may or may not be constipated. The returns for 1839 show 639 deaths from colic and ileus in England and Wales.

This inversion of the action of the intestine is often the result of inflammation, of cancer, or of other structural disease of the intestine; but it sometimes occurs idiopathically, and especially in broken and feeble constitutions.

Its more frequent cause, however, is some mechanical obstruction; and it is singular in how many different ways this may be produced. In some instances a portion of intestine has slipped into a loop, formed by a band of adhesion, which has united the folds of the intestine to each other, or to the walls of the abdomen, or to some other part. The colon also has been found to have taken a round turn on itself, or the right portion to have passed over to the left side, or left portion to the right side. Adhesions of the omentum, or of the appendix vermiformis, have likewise formed a similar loop or noose, and the intestine has been strangulated in it. Sometimes an accidental opening, acting as a noose, has existed in the omentum or mesentery. Ileus, from the intestine being strangulated in the various forms of hernia, is common. The accidental insertion of one portion of intestine into another, termed intussusceptio, is another cause. In one case, more than 18 inches of the ileum had passed into the caput coli; and in another, the small intestine protruded at the anus. In some few cases the intussuscepted portion has sloughed away, and yet the integrity of the canal has not been impaired. An ulcer of the colon has also communicated with the stomach, and in this manner ileus has been produced.

The following case, quoted from Dr. Abercrombie, will show that ileus is in many instances entirely functional:—A man, aged 40, had violent pain of the abdomen, urgent vomiting, and obstinate costiveness. The pain was at times increased on pressure, but not uniformly so; and his pulse beat at first about 96, but at length rose to 120. The attack had commenced with symptoms resembling cholera, which had speedily passed into those of ileus. After his death a large portion of the small intestines was found in a state of great and uniform distension, without any appearance of inflammation; and, except the lower part of the right lobe of the liver being unusually soft, no other morbid appearance could be discovered on the most careful examination.

It has been debated whether, in cases of stercoraceous vomiting, the fæcal matter proceeded from the small or large intestines. It is certain, however, that the contents of the small intestines take on the character and odour of fæces—a fact unknown to the older physiologists, and even to Mr. Abernethy. The matters vomited, therefore, for the most part proceed from the small intestines, and only occasionally from the large.

Ileus sometimes comes on in the course of a disease which at first presented no very formidable symptoms. As soon, however, as the stercoraceous vomiting is etsablished, the powers of the patient rapidly sink, and a few hours, two or three days, or at most a week, generally terminate his sufferings. In cases of ileus caused by a mechanical obstruction, pain, increased on pressure, and often of considerable intensity, is present, denoting that inflammation of the constricted part has taken place; and in this case the patient dies in redoubled agony, unless mortification takes place.

Diagnosis.—The stercoraceous vomiting distinguishes this from every other disease.

Prognosis.—The prognosis is not always hopeless, but is, nevertheless, most grave.

Treatment.—Such alleviation as this disease admits of is derived from opium, effervescing draughts, mild purgative medicines, opiated enemata, or mercury and opium by inunction. Popular opinion, which has termed this disease " Lord have mercy upon us," seems to consider it entirely beyond the powers of medicine. Instances, however, have been met with in which the patient has been recovered. Pinel, for example, mentions a case in which the matters vomited were supposed to be decoctum malvæ, which had been thrown up the rectum half an hour before, and yet the patient did well.

When ileus depends on a mechanical cause, the intestine sometimes rights itself; otherwise, neither art nor medicine afford relief.

Diarrhœa is a discharge of frequent loose watery motions; and there is hardly any agent, moral or physical, that acts on the human body, that is not capable of producing it. The passions, heat or cold, changes of weather, changes of wind, or any unusual indulgence at table. Many known morbid poisons, and probably many ephemeral ones, not yet determined, are also its frequent cause; and so general is this disorder, that every age is liable to it, as likewise either sex, and, perhaps, in nearly equal proportions.

Many opportunities present themselves of examining patients who have died of diarrhœa; but often not the slightest appearance of inflammation or other structural disease in any part of the alimentary canal can be found. It is consequently in a great number of cases a disease purely functional.

Some speculations have been entertained as to the seat of diarrhœa, or whether it results from a diseased action of the small or the large intestine. From the quantity of fluid occasionally found in the small intestine, there is no question of that portion of the alimentary canal being often the seat of diarrhœa. In other cases the colon is, perhaps, in like manner exclusively affected; but probably it is more common that both portions are simultaneously affected.

In diarrhœa the fæcal discharge often deviates from health, not only in consistency, but also in colour, being sometimes white or clay-coloured, or else green or black; and the question arises whether this discoloration is owing to a diseased state of the bile, or to the morbid secretions of the intestinal canal; and it may be affirmed to be more often owing to the latter than to the former.

In diarrhœa the bile is, perhaps, often faulty; but on examining the bodies of those who have died of this complaint, we often find the bile in the gall-bladder healthy, and also the matters contained in the duodenum healthily coloured with bile; but in the lower portions of the intestines one portion of the fæcal matter may be white, another green, and, perhaps, another natural; the colouring matter of the bile having been discharged or otherwise acted upon by the secretions of the intestine; and sometimes the fæcal matter is of a healthy yellow colour in the small intestines, and green or white throughout the whole extent of the large.

Symptoms.—In diarrhœa the stools are frequent and watery, and sometimes mixed with blood; often accompanied by flatulence, and by pain more severe immediately before passing a dejection. Their number is very various, or from three or four to thirty or more in the course of the twenty-four hours. They are generally copious; and Morgagni states, that in his own case he once passed 16 lbs. in a very few hours. The duration of the disease varies from a few hours to many months.

For practical purposes idiopathic diarrhœa is divided into two kinds, or into that in which the *tongue is clean*, the pulse quiet, and all constitutional re-action absent; and again into that in which the *tongue is white* and coated, the pulse accelerated, some fever present, and the pain or soreness constant, and increased by pressure. The stools in either case may be black, green, white, or mixed with blood indifferently.

Treatment.—When the *tongue is clean*, if the disease be quite incipient, the most usual practice is to give one dose, consisting of an opiate, combined with a gentle cathartic, as opii gr. j., c. pulv. rhei ℈j., to remove any offending matter that may be present. These medicines having produced their intended effect, we may now exhibit medicines more distinctly astringent. In many cases a drachm of syrup of poppies after each stool is sufficient. In severe forms of the disease, aqua menthæ piperitidis ʒ ſs. c. pulv. cretæ comp. c. opio ℈j. to ʒ ſs. every four or six hours, is an excellent prescription; and these medicines may be used whether blood be or be not in the stools. If the opiate and aromatics contained in the above medicine should prove insufficient, it may be necessary to add to each dose some of the class of pure astringents, as a drachm of the tinct. kino, or catechu, or hæmatoxyli.

There are cases of diarrhœa with a *clean tongue*, which will not yield to opiates, astringents, or stimulants, either singly or combined, and which probably depend on a want of tone in the intestine; and in these cases five grains of salicine every four or six hours have often stopped a diarrhœa that appeared fast hurrying the patient to his grave.

When diarrhœa is accompanied by a *white furred tongue*, together with pain and soreness, it is necessary to exhibit opiates, combined with some mild purgative. Thus aqua menthæ c. magnesiæ sulphatis ʒ ſs. to ʒ j., with a drachm of syrup of poppies; or 15 minims of the tinct. hyoscyami; or, in severe cases, with iij. to v. minims of tinct. opii 4^{tis} vel 6^{tis} horis, are remedies on which, as a general principle, we may very confidently rely. In other cases rhubarb, castor oil, or any other mild purgative, may be substituted for the Epsom salts. In cases of diarrhœa, accompanied by vomiting, a drachm of syrup of poppies, *neat*, repeated every half hour or every hour for two or three times, often quiets the stomach, and enables it to bear the other remedies; or soda water, or the effervescing draught, with a table spoonful of brandy, with or without a few minims of tinct. opii, often remain when everything else is rejected.

Most practitioners lay great stress on the colour of the stools, and the necessity of correcting the supposed morbid states of the liver; but it has been shown that the various colours of the stools are caused rather by morbid secretions from the surface of the mucous membrane of the intestines, than by any defective state of the bile in the gall-bladder; and the conclusion from this consideration is, that in simple diarrhœa mercury in any form is either unnecessary or injurious in the great majority of cases. In a smaller number, however, it is sometimes necessary, and more especially in children under four years of age. One general law may be said to be established in the cure of diarrhœa, which is, that in the adult, whatever be the form of the diarrhœa, if the stools be dark at first, and then become light coloured, purgative medicines are no longer beneficial.

The dietetic treatment should be limited to slops, puddings, and white fish, and the drink to weak brandy and water, which acts locally as an astringent, and generally as a diffusible stimulus.

Constipatio is a retention of the stools beyond the usual period, so that when they are passed it is with difficulty, and comparatively in a hard indurated state.

Remote Causes.—The remote causes of this affection are extremely numerous. Every form of indigestion, for instance, may be a cause of constipation. Hæmorrhoids, or piles, is another frequent cause; as well as a too sedentary life, especially if too strictly applied to study. Also women labouring under amenorrhœa, or other functional disease of the uterus, have often constipated bowels; and almost every acute disease is occasionally ushered in by constipation. It is likewise a common concomitant of most chronic affections, as dropsy, diabetes, hydrocephalus, pyrosis, rheumatism, or mania. Many articles of diet are causes of constipation, as brandy; many mechanical accidents, also, as stricture of the alimentary canal; many medicinal substances, as lead, opium, or other astringent, are all causes productive of constipation.

Predisposing Causes.—Persons of all ages are liable to this affection; but it is most common, perhaps, after the middle periods of life. Both sexes suffer from it; but women, from their more sedentary lives, the greater capacity of their colon, and their greater delicacy on these subjects, are most disposed to it. When pregnant, it is a frequent complaint with them, as some suppose, from the pressure of the enlarged uterus on the colon.

Pathology.—This disease is essentially a disease of function, and often exists without the slightest trace of organic lesion. Its physiological cause appears to consist in want of sensibility of the nerves of the mucous membrane of the alimentary canal to the stimulus of their ordinary fæcal contents, so that the peristaltic motion downwards is retarded. It has been a question in what portion of the alimentary canal constipation takes place; and most authors have placed its seat exclusively in the large intestines. In posthumous examinations however, formed, lumpy, hardened fæcal matter is sometimes found in the small intestines; and hence it is manifest that the seat of constipation may be either the small or the large intestines, and, perhaps, most frequently in both.

Symptoms.—It is a law of the animal œconomy that most persons in health have one evacuation daily, and

at the time when the organic sensibility is heightened by repose, as on getting up in the morning; or when it is excited by a meal, as after breakfast. If this period be prolonged the fæces become hard, knotty, or scybalous, and ultimately form large round balls. This retention of the fæcal matter often causes great distension of the abdomen, as well as pain, irritation, and a flow of blood from the rectum on the passing a stool. In some instances the fæcal matter, whether retained in the caput coli or other part of the intestinal canal, causes so much irritation that constipation and diarrhœa co-exist at the same time, the solid matters being retained, while the more fluid portions give rise to repeated stools. A complication often confirmed by the evidence of repeated examinations after death. Such are the local symptoms.

The general symptoms are not less distressing than the local affections. The appetite is in general lost, the head aches, a gloom is cast over the spirits, the mind and body are indisposed to exertion, the temper is soured, and every pleasure of life embittered. The effects of constipation are so well known, that in some courts it is said to have been a rule never to ask a favour till after the monarch's bowels had been freely opened. Besides this general influence of constipated bowels over the healthy state of every function, there are few disorders which are not aggravated by its continuance, and few that are not benefited by its removal, while many are cured altogether. There is, indeed, no rule of health more important than that the bowels be kept regularly and daily open.

Instances of constipation of two, three, four, five, to, perhaps, fifteen days are not rare. A gentleman under the care of Mr. Benjamin Phillips passed thirty-seven days without any evacuation. In a case related by Dr. Willan, of a monomaniac who destroyed himself by a voluntary religious fast, the patient had a stool on the second day of this course, but not again till the fortieth day. An instance occurred to Dr. Williams, St. Thomas's Hospital, and related by Dr. Burne, in which the patient, a lady, had only four stools in a year; while a young lady, aged 18, was attended by Dr. Burne, who passed neither flatus nor fæces for six months.

The quantity of fæculent matter discharged in a state of health is about five ounces; but in cases of constipation the quantity passed at one motion is often quite extraordinary. One case is related by Dr. Warner in which the party, a lady, passed in a short time forty-two lumps, each as big as a hen's egg. In the case of Dr. Williams, the quantity passed at each motion filled a common-sized pail, and consisted of a number of lumps of healthy fæces, each as big as the head of a full-grown fœtus. Indeed, the passage of each lump gave as much pain as if the party had actually brought a child into the world. In some instances the fæcal matter retained collects in the caput coli, and forms a tumor so considerable that it has been mistaken for fungus hæmatodes, or an aneurism.

Treatment.—When the constipation is accidental and of short duration, any of the milder cathartics, as the sulphates of soda or of magnesia, castor oil, rhubarb, aloes, or the confectio sennæ, or the pilulæ colocynthidis comp., will in general remove it. If, however, the constipation is habitual, these laxatives should be continued daily for a short period till the *healthy habit* of a daily evacuation be established.

The remedies that have been mentioned, though often successful, yet occasionally fail from the low tone of the sensibility of the mucous membrane of the intestine. In these cases the combination of a tonic with a purgative will often produce a more efficient action than the purgative alone. Thus we often find two grains of the ferri sulphatis, or an ounce and a half of infusi gentianæ, combined with a drachm of the sulphate of magnesia, and exhibited, according to the urgency of the case, three times a-day, or every six hours, will often produce catharsis when the salt alone would fail. In old persons, also, we find that a combination of aromatics with the purgative, as in the decoctum aloës, is a more useful and effective remedy than the same or even a greater quantity of aloes exhibited alone.

When constipation does not yield to the simple treatment which has been mentioned, recourse must be had to larger doses, or else to more active purgatives. Thus calomel, gr. v., c. jalapæ, gr. xv., is a dose which rarely fails even in our public hospitals to produce motions, and this, if necessary, may be followed up four hours after either by the neutral salts in divided doses, or else by a black draught in one dose. If a stronger medicine than the above be necessary, elaterium is of greater power, and one or two grains will sometimes produce hypercatharsis. Elaterium, however, often produces vomiting; and in these cases a drop or two of croton oil is a remedy which may be substituted with success, as it sits easily on the stomach. The catalogue of purgative medicines, however, is large; and when the more powerful medicines are necessary, recourse should at once be had to medical advice.

If medicines by the mouth have been insufficient, it is desirable to hasten their action by enemata. The enemata may be simply a pint of warm water, 100° Fahrenheit; or the same quantity of warm water, with half an ounce of common salt. The common soap enema is likewise a valuable remedy; and when the constipation is great, half a pint to a pint of castor oil, *neat*, may be thrown up.

Sometimes the fæcal matter accumulated in the colon is so large in quantity, and so hard and impacted, that manual assistance is necessary to relieve the patient. "Mrs. W. had suffered for years from constipated bowels; but when I saw her," says Mr. Jukes, "a contrary state of bowels had taken place, she being much harassed by purging, which had existed more or less for many months. At length violent tenesmus came on, with a bearing down most intolerable, much worse, she said, than she had ever suffered in any of her confinements. I examined the rectum, and found a mass of hard matter which I could not break to pieces without the aid of an instrument." The mass consisted of a variety of undigested substances, which, when broken down, were washed away by injections, to the perfect relief of the patient.

Dietetic Treatment.—The patient suffering from constipation should avoid port wine or brandy, and should eat freely of sub-acid fruits. The advice of Mr. Locke should also be strictly followed, or that he should go daily at the same hour to stool; for such is the periodical regularity of all the functions of the body, that they are more regularly performed at accustomed hours than at any other time.

Having thus described the diseases of the alimentary canal arising from general causes, it is now necessary to apply ourselves to those arising from specific causes, or from entero-lithates, from worms, from the too abundant use of salt provisions, causing scurvy; also to those

Elementary Principles of Medicine.

caused by the effects of lead, of alcohol, and of fish poisoning.

Of Entero-lithates.

Entero-lithates.—This term has been given to the great variety of organic and of inorganic substances which, having been swallowed, are sometimes found either in the stomach or intestines. The organic substances are principally the husk of the oat-cake formed into balls, and which are occasionally met with in the stomach; and also plum or cherry stones. In a youth who died of colic and convulsions, the cœcum was found stuffed with a large number of cherry-stones. In another patient, who died after three years' suffering, the colon was found distended with about three pounds of cherry-stones and about forty lead balls, which he had swallowed in the hope of obtaining ease. When it was the fashion to take mustard-seed as a medicine, these were often passed in large quantities. One gentleman sowed some of them, and they throve well. Dr. Prout saw a lady of title who passed what appeared to be larks' bones.

The inorganic substances are as various as those of the organic kingdom. The eating of pounded glass is not uncommon; and, if broken into small pieces, Chalissièr considered it as perfectly inert, and even large pieces swallowed are often productive of little other inconvenience than a scratch of the throat. Sauvages made dogs swallow bits of glass of various sizes, and with such impunity that he ended his experiments by swallowing some himself, and without any notable accident. Portal saved a young man who experienced alarming symptoms after swallowing fragments of glass broken between his teeth, by first making him eat large quantities of boiled cabbage, and then giving him a vomit.

To swallow pins is a common mode, in some countries, of committing suicide, and the usual mode of getting them down is by enveloping them in wax. Sometimes, also, they are given with an intention of destroying others. In April, 1838, a healthy child of two months and a-half old was seized with a paroxysm of suffocation, and its life appeared to be in danger. The mother, however, on examining what had passed from this child's bowels, found in the first stool three pins, in the second four, and in the last two pins. This child was nursed by a servant girl of weak intellect, who admitted that she had given them to the child in one of those paroxysms of irritation which accompanied her menstrual period.

Pins thus swallowed are sometimes found, as in the above case, in the bowels; in others in the stomach; and sometimes in various other parts of the body. Olivier examined a stone patient, that died after the operation, and found a bent pin making its way through a fold of the mucous membrane of the stomach, which had caused no other alteration than a slight thickening of the part where the pin was lodged. More commonly, perhaps, they make their way either to the surface or to some other part of the body. Dr. Silvy gives a case in which 1400 pins or needles were found implanted in the different muscles or organs of the body in a maniacal girl who died of phthisis. None, however, were found in the lungs. Boisseux has given a similar case of a young woman who, during a delirium of twelve days, swallowed 800 pins, all of which were extracted from the superficies of the body.

But the swallowing of pins is not always free from danger. Arnaud and Saviard found a large pin in the testes, and which had caused carcinoma of that organ. Schenk saw a case which was fatal from a pin having penetrated the liver; and Bayle another, in which a pin had penetrated the ureter, and caused an abscess in that part.

Besides pins, watches, knives, penny pieces, and half-crowns have been swallowed and retained by mountebanks, or polyphagists, as they are termed. One of these swallowed a silver fork, which, being retained, was removed by an incision. Perhaps among the most remarkable of these entero-lithates is an egg-cup found in the ileum of a man by Mr. Deads. The man was sixty years of age, and for several months had suffered from abdominal ailments. He at length died after stercoraceous vomiting, singultus, and great distension of the abdomen. On examining him, an earthenware egg-cup was discovered impacted in the ileum, about ten inches above the cœcum. The ileum at this part adhered to a hernial sac, and prevented its further passage downwards. Another person swallowed a piece of a flute four inches long; but was more fortunate, for it passed by stool three days afterwards.

Sometimes the intestinal entero-lithates are introduced per anum. Dr. Burne relates the case of a lady who, being supposed to labour under a stricture of the rectum, was directed to use a bougie at her own discretion. Being from home, however, and without a bougie, she substituted at bed-time a piece of wax candle, about six inches long, and which, in the course of the night, slipped into the colon. Within a week she was seized with vomiting and bearing down, so severe, that it led to an examination of the rectum, when, in a mass of fæcal matter, and by no means hard, the candle was found broken in the middle, but held together by the wick.

The largest number of entero-lithates, however, has arisen from the concretion of substances taken as medicine. Mr. E. Brande gives the case of a lady who took a tea-spoonful of Henry's magnesia every night, till it was calculated the whole quantity taken amounted to between nine and ten pounds troy. At length her left side became tender; an obscure tumor could be felt: and after much suffering she passed a large quantity of what appeared to be sand. This was thrown away; but the following day she passed another quantity, which, being measured, amounted to two pounds; and subsequently several soft lumps were passed, which, being analyzed, were found to be the sub-carbonate of magnesia, concreted by the mucus of the bowels, in the proportion of about 40 per cent. In another case, in which no magnesia had been taken for six months, yet from four to six pounds were found embedded in the head of the colon. In a case that proved fatal in St. Thomas's Hospital two large lumps of concreted magnesia, each as big as walnuts, were found in the small intestines. Chalk and sulphur have been found concreted in the same manner.

Worms—Entozoa-Intestinalia (εντος ζωον).

Besides dead or inanimate substances, living animals are also occasionally found in the intestinal canal.

The intestinal entozoa are four in number, or the *Tricocephalus dispar*, or long thread-worm, and the *Ascaris vermicularis*, or common thread-worm, or maw-worm, both of which inhabit the large intestine. Again, the *Ascaris lumbricoides*, or round worm, and the *Tænia*, or

tape-worm; and these two last inhabit the small intestines. These worms were known to the ancients, with the exception of the tricocephalus dispar, which Bremser considers first to have been discovered by Morgagni. It does not, indeed, appear to have been generally known till the year 1760, when it was accidentally observed in the cœcum of a child, five years old, by a student at Göttingen, who showed it to Ræderer and Wagler, who traced it afterwards in a considerable number of French soldiers who were stationed in that city, and died of epidemic fever. It appears to be common in Germany, much less so in France, and still more rarely in this country.

The *Tricocephalus dispar* inhabits the large intestines, and principally the cœcum, and is from one inch and a-half to two inches long. Its body is capillary for about two-thirds to four-fifths of its length. This capillary portion terminates in a minute point, which is its head. The male is smaller than the female, and is known by the posterior or thicker portion of the body being spiral, whilst it is straight in the female. The ova are elliptical.

Oxyuris vermicularis, *ascarides*, from *ασκαριζειν*, to leap, or *maw-worm*, has two sexes; the male, according to Bremser, being from a line to a line and a-half long; while the female is from four to five lines long. Their heads are obtuse, vesicular, and traversed by a tube which is the alimentary canal. These worms augment in size from the head to the termination of the anterior third of the body; and from that point they decrease till they terminate in a point scarcely perceptible even by the aid of a microscope. The tail is spiral in the male, and straight in the female.

Bremser and Rudolphi are satisfied that these animals are oviparous. Their abode is in the large intestines, and especially in the rectum, where they often occur in large numbers, to the amount of many thousands. They take their popular name (ascarides) from their head being in perpetual motion, and from their great general activity; so much so that they sometimes find their way into the vagina, when they cause intolerable itching. Frank has also found them in the urethra. They are most common in childhood, but no age is exempted. Cruveilhier was consulted by a man, upwards of fifty, horribly tormented with them; and Bremser by an old man, upwards of eighty, and who continued to pass them till his death.

The *ascaris lumbricoides*, or *round-worm*, is from two to three lines in diameter, from six to fifteen inches in length, is attenuated at both extremities, is generally of a reddish brown colour, and has a small sulcus or groove on each side, which extends the whole length of the body. The head is distinguished by being rather smaller than the tail, and by being surmounted by three valves, which, being opened, bring into view a small tube, which is the mouth. The two sexes are separate, and the male is known by the greater tapering of the tail, which is incurvated, and by the male organ having a double spiculum. The oviducts of the female can readily be seen through its transparent membranes, and appear to fill nearly the whole body. This worm is also oviparous.

This worm inhabits the small intestines, although it is sometimes found passing upwards to the mouth and downwards to the rectum. They have consequently been known to make their way into the œsophagus, and to creep into the nares, and even into the larynx, trachea, and bronchi. The biliary ducts of the liver have been seen full of them; they are said also to have been found in the gall-bladder and pancreatic ducts; and Laënnec states he once saw not only a great number of ascarides in the stomach of a child, but also in the pori biliarii, which was full of them, while the liver looked as if it had been gnawed by them. They have also been known, in passing downwards, to get into the appendix cæci, also to escape through ulcerated openings into the cavity of the abdomen, or into the bladder and vagina; and, by means of an external fistulous opening, through the walls of the abdomen.

The number of ascarides found in any individual in this country seldom exceeds one, two, or three; but Dall' Olio tells us he threw up, in the course of a fortnight, 450 of them. Marteau de Grandvilliers knew a soldier who passed 367 in six days; and Dr. Hooper speaks of a girl, only eight years old, who voided upwards of 200 in a week. Frank knew of a case where eighty of them, rolled up as a ball, were expelled *en masse*, and alludes to another where the intestines, both great and small, were stuffed with them.

The *tænia*, or *tape-worm*, has a head so extremely small that it is hardly visible to the naked eye, and possesses a power of contraction so great that it sometimes appears long and narrow, and sometimes broad and short. This head has also four suckers (*souçoirs*), which are sometimes prominent and sometimes retracted; and, when the head is elongated, we see between the four suckers a protuberance or disc, on which is sometimes observed a double row of little crochets; but, as they are not always present, Bremser thinks this crown of crochets is lost by age.

The neck of the tænia is flat, of variable length, and without articulations. This unarticulated neck is joined to an articulated body, of which the first joints are narrow, and always broader than long. Towards the more central parts of the animal they are square; and after this they form oblong parallelograms, whose length greatly surpasses their breadth.

On the edges of the articulations, in some individuals at least, are seen two white lines, placed one over the other, and which extend along the whole body of the animal. These lines Rudolphi considers to be the alimentary canal, and to derive their origin from the suckers in the head. At each corner, also, of the best-developed articulations are sometimes seen small papilliform protuberances, each having a very visible foramen in the centre. These foramina were formerly supposed to be so many mouths, but modern naturalists consider them as so many oviducts. The male organs of the tænia have not yet been discovered.

The breadth of this worm varies much. The head is frequently not more than one-half to one-third of a line in breadth; but it gradually augments till its breadth equals three, four, and even six lines. The thickness of the tænia also varies much; some are thin and almost transparent, while others are thicker and more fleshy.

"Nobody," says Bremser, "has, I believe, seen an entire tænia, or one at once provided with a head and a tail, for it constantly happens that the last articulations, which are usually loaded with fœcundated eggs, are detached, and evacuated by stool, before those nearest the head are completely developed; and for this reason we cannot correctly determine the length this worm attains, nor the number of articulations of which it is composed. The length of the tænia, however, is very great; and tæniæ of twenty-four feet long are not un-

common. Robin found, in the dead body of a man who had recently passed a portion of it many feet long, a tænia which he estimated at thirty feet. The early writers make mention of tænia of much greater length; as Reinlein, one of between forty and fifty aunes. Pliny mentions one of 300 cubits; and, in the Dissertations of Copenhagen, one is related as having been 800 aunes long; and, if this be true, supposing the aune to be only twelve inches long, the worm must have been coiled up twenty times, from one end of the intestine to the other, forming a mass which would destroy all peristaltic motion.

Naturalists possess no satisfactory information of the reproduction of tænia. The articulations being similar to each other has induced many persons to consider them as so many distinct animals, generated one after the other, and connected together; but this opinion is no longer entertained. Blumenbach and Bremser affirm that the worm is a complete animal at birth; the articulations of the tail being first developed, and even detached, before the anterior articulations are yet visible, or only form a kind of elongated neck. The age which the worm attains, as well as the time necessary for its perfect development, are not yet determined.

"The motions of the tape-worm, whether whole or after division, are often," says Rudolphi, "most active; and people in whom it exists are sometimes conscious of its undulatory and disagreeable movements; and portions of many feet are said to have been protruded and afterwards drawn up by the mere effort of the animal. The habitat of this animal is the small intestine. There are said to be many different species of it.

Remote Cause.—As these intestinal entozoa differ from any known earth-worm, they are considered to belong to the class of parasitic animals. As all of them exist either in fish, in the ox, in the sheep, and in the animals generally which we use for our diet, it seems possible that the ova may be introduced with our food, the incubation being only perfected in those persons whose morbid state of the intestine affords them a fit nidus, or a large quantity of mucus.

Predisposing Causes.—Worms of every description are more common in childhood than in adult age; and in the leucophlegmatic child of weak digestion, than in the strong and healthy. The same temperament also favours their development in the adult. As a general rule, they are common in proportion to the quantity of vegetable food on which the party lives, that diet favouring the secretion of mucus, which is the nidus of these animals. From this circumstance, perhaps, they are more common in France than in this country; in Egypt than in France; while in the East Indies, where the Hindoo lives on rice, nine persons out of ten are infested with these animals.

Pathology.—The portion of intestine inhabited by the worm is sometimes a little redder than usual, and sometimes paler, and is generally loaded with mucus, in which these animals delight to live. It has been supposed that the worm possesses the power of perforating the intestine, or even the substance of the liver; but they have no organ fitting for this purpose, and appear incapable of injuring the intestine otherwise than by their perpetual motion.

Symptoms.—The existence of worms in *the colon* (as the ascarides) seldom gives rise to much inconvenience until they are sufficiently numerous to pass with the stools. About that time the patient is troubled with much irritation of the rectum, with itching, and often bleeding from the nose, with headache. His bowels also are either constipated or relaxed, the stools exceedingly dark or white, his appetite sometimes lost and sometimes voracious, his sleep disturbed, and his temper fretful; and often, as a result of so many combined irritating causes, remittent fever.

The symptoms of the existence of worms in the *small intestine*, as the tænia and lumbricoides, are often exceedingly obscure, and simulate many other diseases; so that, until a patient has passed a worm or a portion of a worm, we are unable, with any certainty, to predicate its existence; and at no time till we actually see the worm can we determine its species.

The general symptoms of worms of the small intestines are occasional colic, a variable state of bowels, capricious appetite, and headache. The mind is also often so much depressed as to amount to hypochondriasis. Thus, Krause gives the case of a young man who, when troubled with worms, was always seized with uncontrollable fits of laughter; and Giraud an instance of a young man who, under similar circumstances, felt an entire impossibility of walking over anything whatever, even so slight a substance as a piece of white paper; or, if he attempted to do so, he fainted. Hufeland mentions a case in which the patient, without being jaundiced, saw everything yellow; Delisle another that could not bear the sound of a musical instrument. And cases in which St. Vitus's dance, epilepsy, and convulsions have been the prominent symptoms, are by no means infrequent.

When lumbricoides and tænia pass from the small into the larger intestines they are speedily evacuated, and the symptoms are alleviated. When, however, a lumbricoides passes upwards, the symptoms are more marked. In general, the worm is little troublesome till it reaches the upper part of the pharynx, when, either by irritating or getting into the glottis, it often gives rise to a most fearful sense of suffocation. It commonly, however, continues its upward progress till at length it makes its exit, by the assistance of the patient's finger, either through the mouth or nose.

Treatment.—The habitat of the ascarides being for the most part a collection of mucus, the means used for their expulsion is generally some sharp purgative medicine, as two grains of calomel and ten grains of jalap, or as many of scammony, exhibited two or three times a-week. It ought, perhaps, in no instance to be given oftener, for if the purging be continued the intestine is weakened and more mucus secreted, so that the predisposition to harbour them is increased. In weakly children, small doses of Epsom salts will ultimately effect the same object, and with less distress to the patient. Many persons place great confidence in calomel, as a medicine capable of destroying them, but it does not appear to act beneficially except as a purgative, and consequently it is an auxiliary, and not by any means the most valuable part of the treatment.

From the ascarides being situated so near the rectum, enemata have at all times been much used in these cases; and injections of oil have been much commended, and especially of castor oil. But these animals, having no respiratory organs, will live from thirty-six to forty-eight hours in castor oil; from the same cause, tobacco glysters have failed. Indeed, very little benefit has been derived from any local treatment. Warm-water injections tranquillize the intestine, and

perhaps give more relief than anything else. The ascarides are killed by cold; but it is hardly safe to throw a cold injection into the colon of a child.

For the ejection of tænia or the lumbricoides from the small intestines, a great many remedies have been recommended; but, in the present day, practitioners very generally limit themselves to one or two methods, or to a sharp purgative. The celebrated Swiss remedy, purchased by the King of France, was a sharp purgative, and proved to be twelve grains of calomel and twelve grains of scammony, followed shortly after by ℥ſs. to ℥j. of the sulphate of magnesia. It is questionable, however, whether calomel is an essential part of the treatment, for Rossenstein administered it many times, so as to produce salivation, without expelling a single worm; and Brera adds that, in the mines of Lydria, and in the laboratory of Chemnitz, in Hungary, and at Freyberg, in Saxony, where they use much mercury in purifying gold and silver, he has seen worms endemic among the workmen.

In the London hospitals the purgative treatment is seldom adopted, it being more usual to exhibit the oleum terebinthinæ neat. Half an ounce of this medicine makes the patient slightly tipsy, and produces three or four motions; and in these the worm is usually found, the animal having, it is supposed, a great antipathy to this substance, lets go its hold and actively attempts to escape. This medicine may be repeated twice a-week. Three-fourths of the inhabitants of Cairo are said to be infested with tænia, and their remedy is twenty to thirty drops of petroleum; a remedy not greatly dissimilar. The Grenadine bark has acquired much reputation in this disease in the West Indies, but it has not supported the hopes that have been entertained of it, at least in this country.

The situation of these worms render enemeta of little value, but cold quickly destroys them. They seem to rejoice in heat, for Coulet boiled a tænia in veal broth for twelve hours, and it was as lively at the conclusion of the experiment as at the commencement.

The diet in these cases should be nourishing, and intermixed with a considerable portion of animal food.

Scurvy—Scorbutus.—The muriate of soda, when largely eaten in combination with animal matters, acts as a poison, and, like most other poisons, produces in the first instance an extreme depression of the vital powers, which is followed by a general tendency to hæmorrhage from the gums, also into the sub-cutaneous cellular tissue, and from the mucous membrane of the nose, intestines, and of the lungs.

Scurvy is mentioned by Pliny as having occurred in the Roman army commanded by Germanicus. It prevailed also, to a frightful extent, in the army of St. Louis, when he was made prisoner in Egypt. But it was not till navigation was improved, and long voyages undertaken, that this disease became well known from its general prevalence and formidable character. Vasco de Gama, in his first voyage to the East Indies by the Cape of Good Hope, in 1497, lost 100 men out of 160 by this affection. James Cartier, in his second voyage to Newfoundland, in 1535, speaks of suffering still more severely, as, of 110 people, there were not ten whole; and it is plain he considered it to be contagious. The scurvy continued to prevail, with little abatement, till 1794, when an improved state of society, and a better diet introduced into the navy, have so reduced it that, in the year 1839, only 101 cases are reported to have died of scurvy in England and Wales.

Remote Cause.—The remote cause of scurvy is, unquestionably, the too abundant use of salt provisions; and the whole history of the disease is a proof of this fact. In the middle ages, as they are termed, scurvy prevailed epidemically among the inhabitants of the low countries of Holland, Friesland, Brabant, Pomerania, Lower Saxony, and, indeed, in all countries from the 50° to the 60° of north latitude. This was caused by the absolute want of winter food for the cattle, so that it was necessary to kill them on the setting in of the frost, and either to salt or dry the flesh. Hence the large stores of salt provisions found in the larder of the elder Spencer, in the days of Edward II., even so late in the spring as the 3rd of May, or 600 bacons, 80 carcases of beef, and 600 muttons. In all these countries, however, in proportion as agriculture has advanced, and a succession of green crops enabled the farmer to kill his best and fattest meats in winter, and in proportion, also, as vegetables have been introduced at our tables, together with a liberal use of wine, so has this disease disappeared. The former universal prevalence of scurvy, also, in the navy, and its almost entire disappearance in the present day, necessarily has reference to a particular cause, or the too abundant use of salt provisions. "In 1797 the victualling of the navy was changed, greatly improved, and strictly regulated; and, immediately consequent to the change, the health of the seamen improved strikingly. Scurvy, typhoid fever, dysentery, and putrid ulcer, which, up to the period of the change, produced great havoc, became comparatively rare in occurrence and light in impression." "Since 1797 the improvements have been, giving cocoa instead of gruel (burgo) for breakfast, issuing salt meats at a much earlier period after being cured, the supply of better articles and in greater abundance by one-third, and also the substitution of tea in the afternoon instead of spirits; and, with every improvement in these respects, there has been, as a general result, a further improvement in health, till the four forms of disease, at no distant date so destructive, are scarcely known except by name."

It seems probable, however, that there may be other causes, which, combined with peculiarity of idiosyncrasy, are capable of producing the disease, for a few cases (and the number is but small) apply to the hospitals with what has been termed the land scurvy; the patients, according to their own account, not having eaten either salted, cured, or smoked meats; a form of disease which appears to have broken out among our troops a few months ago, at the Cape of Good Hope, while defending the back country from the Caffres.

Predisposing Causes.—Scurvy is seldom seen except in male adults, between the ages of fifteen and forty, that class of persons being most exposed to the remote cause. It seldom, however, occurs in women, for they are rarely placed under the necessity of living on salted provisions; but when they habitually indulge in what is usually termed "a relish," they often suffer from it. The other predisposing circumstances are insufficient nutriment, severe disease, anxiety, and wet or damp. The effects of anxiety of mind, in producing the disease, greatly struck Dr. Lind. "We often observe," he says, "our channel cruisers overrun with scurvy; while their consorts, fitted out at the same port, and consequently with the same state of provisions, and striking out into the main ocean, upon a voyage to India, or

upon a much longer cruise off the Canaries, or Cadiz, keep free from it." He also remarks that the warrant officers, who lie in warm dry cabins, and go better clothed, are seldom attacked with it; while the common sailors, exposed to wet, and whose berths were seldom dry, were almost destroyed by it. Spirits are said also greatly to predispose to this disease.

Pathology.—The days of scurvy were not those of posthumous examinations, and our knowledge of the pathology of this disease is derived principally from Poupart and Lind. In those cases in which flux or dysentery is absent, the intestines, however copious the hæmorrhage from them, have been found perfectly sound. The principal effects of the disease were observed in all cases in the cellular tissue of the extremities. The quantity of congealed blood effused in that part, even where no stain or mark could be perceived on the skin, was quite astonishing. "It often lies," says Lind, "in large concrete masses on the periosteum, while the bellies of the muscles of the legs and thighs seemed quite stuffed with it, often an inch in thickness." He also often found water effused into the cavities of the chest and abdomen, and no less frequently blood,—the quantity of blood effused in all parts sometimes amounting, in his opinion, to no less than a fourth part of that contained in the whole body. Poupart gives some further particulars, and says that, on moving the limbs of some scorbutic patients, a noise is heard; and that, on examining the joints, the epiphyses had entirely separated from the bones; and in other cases, that the cartilages of the sternum had separated from their bones. He says, also, if we squeezed the ribs which had begun to be thus separated from their cartilages, "there came out abundance of corrupted matter, so that nothing was left of the rib but its bony plates." The mesenteric glands, also, were usually enlarged, the spleen often three times bigger than natural, and fell to pieces as if composed of coagulated blood. In two cases lately examined at St. Thomas's Hospital, patches of ecchymoses were found under the pericardium covering the heart, and also under the arachnoid membranes covering the brain.

Symptoms.—Scurvy is divided into two kinds, or into sea scurvy, *scorbutus maritimus;* and land scurvy, or *purpura scorbutica.*

The first symptoms are, a yellowness of countenance, great depression of the physical powers, followed by the gums swelling, becoming *spongy*, and readily bleeding. A small puliose eruption (like flea-bites), of a purple hue, is next seen on the lower extremities; and about the same time the muscles of the leg or thigh become hard and painful, and in a day or two the skin over the pained part becomes first yellow and then purple. This discolouration forms patches sometimes as big as the palm of the hand, and then again extending over half the leg and thigh. The tongue is now white, the breath fœtid, and the stools generally pale. As the disease advances, all these symptoms are aggravated. The loss of physical power increases, the purple spots have a tendency to ulcerate, and the ulcers are distinguished from all others by their putrid fungoid appearance and great tendency to bleed, old sores open, and the callus of broken bones has even been dissolved and their ends separated. Profuse hæmorrhages also frequently take place from the mouth, nose, lungs, or bowels. The teeth also become loose, so that they either fall out or may be taken out by the finger and thumb. The pulse hurries on to 120 or 140, and at length the patient sinks from diarrhœa or dropsy, and with effusion so sudden that he perhaps has walked to he shaved, and then died in a quarter of an hour afterwards. The duration of the disease is generally many weeks, and sometimes, under the most favourable circumstances, many months, the patient recovering his strength extremely slowly.

The land scurvy is a much milder disease, the patient preserving his general good health. The legs, however, swell, and are painful and covered with petechiæ or patches of ecchymosis. The duration of this form of the disease is also often long and tedious, lasting many weeks or months.

Diagnosis.—The scurvy is to be distinguished from flea-bites, bruises, petechial fever, and from purpura syphilitica.

Prognosis.—In the present day, when the patient can command medical care and proper diet, the scorbutus maritimus, though tedious, is seldom fatal. When these, however, have been wanting, the mortality has been terrible. Lord Anson, it should be remembered, in his voyage round the world, lost above 200 men, and at last could not muster more than six foremast men in a watch fit for duty. At the commencement of the late war, on the fleet returning from sea, it often happened that so many men were landed ill of scurvy, that even Haslar Hospital, large as it is, could not contain them, and many were lodged in the chapel, others in tents, while others died in the boats before reaching the shore.

Treatment.—The early history of navigation, as it records the greatest ravages of scurvy, so does it also record the best antidote to the disease. Lord Anson's people, on reaching the island of Tinian, were recovered principally by eating oranges, of which that noble, brave, and experienced commander was so convinced, that, before he left the island, he ordered one man from each mess to lay in a stock for future security. Sir Charles Wager's people, also, were terribly afflicted with scurvy in the Baltic. Sailing, however, in the Mediterranean, and having heard how effectual oranges and lemons were in the cure of this disease, he took on board, at Leghorn, a large quantity of them, ordered a chest each day to be brought on deck, and allowed the men, besides eating what they chose, to mix the juice with their beer, and also to pelt each other with the rind, so that the deck was strewed with the fragrant liquor. By these means he brought his men home in good health.

In the year 1747, Dr. Lind made some comparative trials between this and some other modes of treatment, as vinegar, vitriol, and tamarinds, on board the "Salisbury," at sea. As a general conclusion from his experiments, he affirms that orange and lemon juice, or more properly, the citric acid obtained from all the species of the botanical genus *citrus*, or the natural order of fruits called *hesperidæ*, are greatly more efficient than any other remedy in the cure of scurvy.

Notwithstanding this strong opinion of Dr. Lind, the navy continued to suffer severely from the scurvy for half a century, till the Admiralty gave a general order for the supply of lemon-juice. This salutary measure was accomplished by a representation from the Medical Board of the navy, in the year 1795, when Lord Spencer was First Lord of the Admiralty, after a trial made on board the "Suffolk," of seventy-four guns. This ship sailed from England on the 2nd of April, 1794, supplied with a quantity of lemon-juice sufficient

to serve out two-thirds of a liquid ounce daily to every man on board, and this was mixed with their grog along with two ounces of sugar. She arrived at the Madras roads on the 11th September, after a passage of twenty-three weeks and one day, without having had any communication with the land, without losing a man, and having only fifteen on the sick list. Scurvy appeared in a few of the men during the voyage, but disappeared on an increased dose of lemon-juice being administered. "Let this fact," says Sir Gilbert Blane, "be contrasted with the state of the channel fleet, in 1780, when Admiral Geary's fleet returned into port, after a ten weeks' cruise in the Bay of Biscay, with 2,400 men ill of scurvy; and let the state of this fleet be contrasted with that of the channel fleet in 1800, which, by being duly supplied with lemon-juice, kept the sea four months without fresh provisions, and without being affected with scurvy."

It is, perhaps, hardly fair to attribute the improved health of the navy entirely to the introduction of a daily allowance of lemon-juice, considering that the quantity was greatly increased and the quality of the diet greatly improved contemporaneously with this addition. It is gratifying, however, to see how largely these combined measures have improved the health of the navy and rewarded the cares of those who superintend it; for, during the nine years preceding these changes, the sick seamen sent to the hospitals were one in 3·9, while in the nine succeeding years the proportion was only one in 8·4; so that not only has scurvy almost disappeared from ships of war and naval hospitals, but the efficiency of the navy has actually been increased three-fold. The negantia in sea scurvy are bleeding and mercury. When the patient has been bled it has been found that the red globules and fibrine are decreased and the albumen increased; the red globules being 119, the fibrine 1·6, and the serum 86 (Andral).

The citric acid, however, although an antidote to sea scurvy, is by no means so with the *land scurvy*. In this latter disease, contrary to the former, the patient is generally benefited by the application of leeches to the legs, and by moderate purging. The cathartic is perhaps unimportant, but the sulphate of magnesia ℥j. ex infusi rosæ ℥fs. ter die, is often efficient.

The diet in every form of scurvy ought, as far as possible, to be fresh meat and vegetables; and, where it can be procured, a daily allowance of wine or porter. It is said that two vessels went on shore on the inhospitable coast of Greenland; one saved salt provisions enough to carry them through the winter; while the other lost everything, and the crew were obliged to live on what accident threw in their way. On the return of the whalers the following spring, the crew of the former had all died of scurvy, while the crew of the latter were still living.

Of the Effects of Alcohol.

"Dulce periculum est:
O Lenæe sequi Deum
Cingentem viridi tempora pampino."

The number of persons that die from diseases produced by alcohol is calculated to be at least one-fourth of the whole adult male population, together with a considerable proportion of adult females of the lower classes. This estimate will appear less extraordinary, when it is stated that, besides producing intoxication, this fluid, like other poisons, is absorbed and mingles with the blood, and may be obtained from the blood by distillation. Its presence in the circulating system is not harmless, for it causes many organic as well as functional diseases. The organic diseases are altered structure of the arteries, also of the liver, of the stomach, and of the kidneys. The effects of alcohol on the arteries, and especially of the aorta, as constantly seen in the drunkard, are thickening and thinning, ulceration and ossification of the coats of those vessels, and in this manner their elasticity is destroyed, and they are rendered pouchy and aneurismal. The diseased state of the arteries re-acting on the heart produces enlargement and hypertrophy of that organ, till the whole balance of the circulation is destroyed, and the patient rendered liable to apoplexy, asthma, and dropsy. Besides the specific effects of alcohol on the arteries, it likewise affects the liver, which usually becomes enlarged, hardened, and granular. The stomach, also, is generally indurated, thickened, and contracted, while the kidneys are liable to every species of disorganization.

Such are the structural lesions alcohol produces; but in addition to these, many functional diseases result which often end in the death of the party: thus it is intimated that one-third of all the cases of insanity arise from habits of inebriety. In some persons, indeed, every fit of intoxication is a fit of insanity, and most of the murders, acts of incendiarism, of insubordination to military discipline, or of brutal violence, are committed during the paroxysm. The diseases of function it is now intended to note, and which are the immediate result of alcohol, are *delirium tremens*, or the consequences of several days continued intoxication, and *asphyxia temulenta*, or the fatal consequences of drinking to great excess at one bout.

Delirium Tremens is a general and excessive disturbance of the functions of the cerebral and nervous systems, causing sleeplessness, hallucinations, great trembling of the hands and upper extremities, with or without fever, and is a disease which runs a short and often fatal course.

This disease was little known till Dr. Sutton called the attention of the profession to it in the beginning of the present century, as an affection he often met with among the smuggling sea-faring population on the coast of Kent. Since that time it has become well known, and 206 cases died from it in 1839 in England and Wales, while the returns from the East and West Indies show that it is frequent in our colonies.

Remote Cause.—The party affected with delirium tremens is not the wine and beer drinker, but the drinker of spirits to such excess as to be in a continued state of intoxication for several days. It is consequently most usual in London about holiday time.

Predisposing Causes.—Both sexes are liable to this affection, and of the 206 who died in this country of this disease in 1839, 184 were men, and 22 women, and we regret to add that this proportion of females is greater than in many continental towns.

Pathology.—The pathological phenomena which have been discovered on the inspection of those who have died of delirium tremens have been a few more *puncta cruenta* than usual of the brain, and also some thickening or congestion of the membranes, with effusion into the cavities of the arachnoid and of the ventricles. In some very few instances the fluid in the ventricles has smelt of the spirit that has been drank, and so also has the blood drawn from the arm.

Symptoms.—The symptoms of delirium tremens generally appear from the second to the eighth or ninth day after a protracted debauch, and are by some pathologists divided into three stages. The first stage, according to Dr. Blake, is marked by a peculiar slowness of the pulse, by coldness and clamminess of the hands and feet, by general debility, by nausea and vomiting in the morning, and by frightful dreams at night. The tongue, also, is tremulous and furred, the hands shake, the patient is greatly depressed in spirits, sighs frequently, is anxious about his affairs, and is either restless or watchful. These symptoms last from 24 to 48 hours.

The second stage commences by a hurried and anxious manner, by great excitability of temper, by a small accelerated pulse; some heat, perhaps, of the surface of the trunk, but accompanied with the same coldness and clamminess of the extremities. The tongue is sometimes clean, but often brown and dry, and the patient delirious, suffering from various mental illusions and alienations. In general, the delirium is melancholy, and has reference to his usual occupation and habits, or to some difficulty in his domestic affairs. He sometimes sees flames, or hears voices talking to him; and one man, as soon as he shut his eyes, saw people passing under the bed-clothes. Restless and sleepless, he moves his trembling hands horizontally over the bed-clothes, as if seeking for something. In general, he is harmless, and easily controlled; but in some instances the party is violent, mischievous, and requires to be strapped down in bed. This stage generally lasts from three or four days to a week, when the third stage commences by the patient falling into a sound sleep, and gradually recovering, or else a fatal collapse comes on, which finally and shortly closes the scene.

Diagnosis.—Delirium tremens is to be distinguished from typhus fever and from paralysis agitans only by the previous history.

Prognosis.—It is hardly determined what is the proportion of recoveries to deaths, but unquestionably three persons out of four do well.

Treatment.—The rule of treatment in this disease is by opiates and stimuli. In mild cases, when the tongue is *white*, many recover under mist. camphoræ ℥ xj. sp. æth. nitr. ℥ j. c. syr. papaveris ℥ j. vel tinct. hyoscyami ♏ xx. 4tis. In severe cases, when the tongue is either clean or brown, one or two grains of morphine or of opium, given every two hours till sleep is procured, has entirely cured the patient. It is, generally, however, necessary to support the patient for some days after by camphor mixture, and by a small portion of wine and water, or brandy and water. By physicians who have attempted the heroic treatment, as much as ℥fs. of tinct. opii, or 20 grains of opium, have been given at a dose in these cases, but this appears to be in great excess.

The dietetic treatment should be slops and light farinaceous food.

Asphyxia Temulenta.—Delirium tremens is generally the result of some days' hard drinking; but some persons, either through bravado, for a wager, or from ignorance, have been tempted to drink one or two pints of spirits at one draught. In these instances the effects of the poison are widely different from the delirium tremens caused by long-protracted debauch, for instead of excitement, delirium, and tremor, the brain becomes oppressed, and the patient falls down, and lies without any power of voluntary motion, without consciousness, and almost without sensation, and in this state he frequently and shortly dies.

Pathology.—On examining the bodies of those who have died during intoxication, the appearances observed are those of asphyxia rather than of apoplexy. The appearances, indeed, are rather external than internal; the countenance bearing marks of anxiety, and sometimes of convulsions; the eyes being prominent, and the pupil dilated; the face swollen and livid; the lip blue; the cellular tissue vascular, and its blood dark and fluid; all the abdominal and pectoral viscera likewise are loaded with dark fluid blood, as also the brain and its membranes. The veins and larger arteries, as also both sides of the heart, are loaded in like manner with black blood. Some effusion is likewise observed in the cavity of the membranes of the brain, and also into the ventricles, but it is small in quantity, and perhaps is merely a consequence of the agony. These appearances seem to denote a specific action of the alcohol on the nervous system, producing instantaneous palsy of the eighth pair, as well as of the functions of the brain generally.

Symptoms.—In the great majority of cases, shortly after taking the spirits, the party* becomes drowsy, if sitting, and appears to fall into a sound sleep, but, if standing, he falls down; while if the attempt be made, he cannot be roused to consciousness, or only partially so, and then immediately relapses into the same comatose state. His limbs remain motionless, or, if lifted up, fall powerless; his face is pale or flushed; his eye injected, sometimes squinting, and the pupil either contracted or dilated. The temperature of his head is above that of the trunk, which is either natural, or below the usual standard. The pulse is feeble, slow, varying from 70 to 108, and often entirely wanting. The breathing slow, and if the hand be placed over the chest, no expansion is felt, the respiration being altogether abdominal. In four cases, says Dr. Ogden, the patients manifested no sense of feeling, either when the skin was pricked, or the nostril tickled with a feather. The patient generally dies convulsed.

Diagnosis.—The disease is distinguished from apoplexy, or other disease, by the breath being tainted with spirits, and also by the history of the case.

Prognosis.—A very small number of cases recover from this extreme state of intoxication, but when the pulse is wanting at the wrist, the patient cold, and the respiration laborious after the alcohol is removed from the stomach, the case is hopeless.

Treatment.—The practice is, in the first instance, to empty the stomach, either by an emetic, or by the stomach-pump, to apply external warmth, and to exhibit diffusible stimuli, as ammonia; or, according to Orfila, hot coffee; and, according to others, vinegar. The practice of blood-letting, when called to a patient suffering from an overdose of ardent spirits, though a common is yet generally esteemed a most pernicious error.

Colica Pictonum.

Lead has been introduced into the system, both formerly and in the present day, in a great variety of ways; formerly, in France, from putting a lump of litharge or lead into *vin gâtée*, in order to render it saleable, a crime which has been made capital in most countries of Europe; and from this having been prac-

* Ogden, *Medical and Surgical Journal*, vol. xl.

tised to a great extent in Poitou, the disease has been termed *Colica Pictonum*. In the cider counties of Great Britain this disease formerly existed to a great extent, and has been termed Devonshire colic, or *Colica Damnoniensis*. The impregnation of cider with lead in this country was generally the effect of accident, and arose from the troughs in which the apples were crushed having the different pieces of stone, of which they are composed, cramped together with iron, and fixed by melted lead. In some districts it was the practice to line the entire press with lead, or else to tip them with that metal. It was a custom, also, almost universal to make the upper part of the boiling vessel of lead, while some growers, in managing weak ciders, put a leaden weight in the cask to sweeten the liquor. From these and perhaps other causes, Sir George Baker found the cider he examined to contain $4\frac{1}{2}$ grains of lead in 18 bottles, or a quarter of a grain in each bottle. In the West Indies, these diseases appear to have been produced by using leaden worms to the stills, by which the rum became impregnated with this metal. There are many other minor sources of poisoning by lead, as keeping pickles or preserves in glazed earthen vessels, and colouring sugar-plums with lead; while many children formerly suffered from eating wafers coloured with red lead—*cognitio causæ tollit morbum;* and the still and other machinery used in the distillation of fermented liquors being now constructed of metals so combined as not to be acted upon by acid fruits or sugar, these diseases are no longer epidemic, but are confined principally to labourers in the lead manufactories and to painters.

Predisposing Causes.—All ages, both sexes, and all classes are liable to the poisonous action of this metal, but the workers in lead have been at all times the greatest sufferers. Women in this country often suffer from colic, but it is rare to find them paralytic; men suffer both from the colic and the palsy.

Pathology.—The theory of this disease is, that the lead is absorbed and mingles with the blood, and produces that functional disease of the fibrous structure of the alimentary canal, termed colic; also of the muscles of the extremities, producing palsy, and likewise ulceration of the gums and alveolar processes, accompanied by a peculiar blue line, and which has only lately been pointed out by Dr. Burton, of St. Thomas's Hospital.

The fact of the lead being absorbed and mingled with the blood is demonstrated by the circumstance that lead has been obtained from the coats of the stomach of a dog poisoned by lead, even as late as a month after poisoning. Again MM. Duvergie and Guibourt have detected lead in the brain of the human subject, and Dr. Budd has detected it not only in the human brain, but also in the muscles. Many pathologists, also, are inclined to believe that the blue line observed in the gums of persons poisoned by lead is owing to the presence of lead in some peculiar state of combination. It follows, from what has been stated, that there are various tissues of the body for which lead has an affinity, and that it enters into chemical combination with them.

Colica Pictonum rarely causes death in the present day, but the facts we do possess show it to be a disease of function and not of structure. Dehaen opened many persons that fell from this disease, and says he found in all a constriction of the colon, and in a certain number a similar affection of the cœcum. Merat opened, also, seven cases, and all that he observed was a constriction of the colon. Dubois de Rochfort says that he found in two cases intussusception of the intestines; but Andral, however, has examined five cases, Louis one case, and Martin another, without finding any morbid appearance.

Mr. Hunter had an opportunity of examining the state of the muscles of the palsied hand and arm of a painter who died of a broken thigh in St. George's Hospital, and found them all of a cream colour. Dr. Williams, however, of St. Thomas's Hospital, had an opportunity of examining the palsied muscles of the arm of a painter, but they had an entirely natural appearance, though wasted. Dr. Budd had also an opportunity of examining a similar case at King's College Hospital, yet, although the extensor muscles of the wrist and muscular fibres of the colon were examined under a microscope, nothing unusual was discovered, except that the extensor muscles, like palsied muscles in general, were more easily separable into their component parts than in health.

Symptoms.—The quantity of lead necessary to produce its specific results, or the time it takes to accumulate in the system when introduced, is not determined, and both the dose and the time, perhaps, varies greatly in different individuals. Sometimes all its most pernicious effects are produced by one dose taken by the mouth; and then again, if introduced by the skin, mouths and even years may elapse before the system is laid under its influence. As a general rule, however, a much smaller dose will produce colic than is necessary to produce palsy.

When the dose is of such intensity as to produce colica pictonum; the symptoms do not differ, except in being of greater intensity from those which have been stated as marking ordinary colic. There is the same dragging and twisting pain, and the same relief by pressure; the same absence of fever; the same unhurried pulse; the same constipation, only more obstinate, and in the worst cases the same vomiting. Andral, however, who has treated upwards of 500 cases at La Charité in the course of eight years, says it is not strictly true that the pain in lead colic is always diminished on pressure, for in the greater number of cases pressure neither augments nor diminishes the pain, while in some cases the sufferings of the patient are increased by it. He also says it is as common to find the abdomen distended with gas as to find it drawn in, and the rectus strongly contracted. The symptoms peculiar to this form of colic are, occasionally an attack of epilepsy, and an ulcerated state of the mouth, accompanied by a blue line on the dental edge of the gum,—a discovery which the profession owe to the patient and careful observation of Dr. Burton.

The duration of colica pictonum is very various: in one instance lately, in St. Thomas's Hospital, fifteen days had elapsed without a stool. More commonly, however, only three or four days elapse before a stool is procured, and when the case is early submitted to medical treatment seldom more than a few hours. As soon as the bowels act the great severity of the disease is mitigated; every symptom is gradually relieved, and the disease generally terminates within a week.

When palsy is the result of the absorption of lead, a painful state of the arms often precedes it, which at length terminates in palsy. The palsy is in general limited to the upper extremities, when it may be partial or confined to the hands, causing the "wrist drop," or

to one finger. More commonly, however, it affects the whole arm, and sometimes so completely that the patient can execute no movement with it, and when lifted up it falls like an inert mass. Again, sometimes the extensor muscles of the limb are alone affected, and in this case the hand is often strongly closed by the powerful and unresisted action of the flexors. In general both arms are palsied, but not equally so, one being something more affected than the other. Supposing both sets of muscles to be equally palsied, the patient usually recovers the use of the flexors before that of the extensors, so that he can carry a pail of water before he can shave himself. This restoration of the lost power is usually accompanied by pain. In a very few remarkable instances the lower extremities are equally affected, an example of which is now in St. Thomas's Hospital, the extensor muscles being palsied, and the patient walking as if slip-shod, or like a bird. The duration of the palsy under any treatment is always long, and often lasts many months, and in some cases, many years. Both colic and palsy may occur an indefinite number of times. When epilepsy, which is a rare symptom, is produced, the fit does not differ from epilepsy of the ordinary character.

Diagnosis.—This colic can only be distinguished from ordinary colic by the history of the case, and by the blue line on the dental edge of the gums.

The palsy is distinguished from cerebral paraplegia by the history of the case, by the integrity of the intellect, and by the blue line on the gum.

Prognosis.—The termination of lead colic, except where the dose has been in such excess as to produce death in a few hours, is always favourable.

The palsy does not appear greatly to affect the health of the patient, but in some cases it has hitherto not been cured or relieved. In general, however, the patient does recover, although, perhaps, not completely.

Treatment.—The treatment of colica pictonum is extremely simple. The objects to be obtained are to procure stools and allay pain. For this purpose five grains of calomel, fifteen grains of jalap, and one grain of opium should be administered as soon as the patient is seen, and at the end of two hours the mistura camphoræ ℥ij. c. magnesiæ sulphatis ʒj. c. tinct. hyoscyami ♏xx. should be given every two or every four hours till the bowels are freely evacuated, when relief more or less complete is obtained. The mixture should be continued at proper intervals for three, four, or five days, when the patient, though greatly weakened, has in general recovered.

In a few cases, however, the pain continues, and with considerable severity, after the bowels have been freely evacuated. The practice in these instances is to apply a blister to the epigastrium and to keep it open for a few hours; and this additional application completes the cure. Calomel to salivation has not appeared to influence the disease beneficially, and bleeding is decidedly bad practice.

In addition to the purgative treatment, the patient is much relieved if placed in a warm bath, and so simple is the treatment of this colic, that Dr. Wilson, of the Middlesex Hospital, affirms, if the patient be now directed to inject repeated enemata of the water of the bath, that stools will be readily obtained. In the absence of the warm bath a large linseed or mustard poultice should be applied over the abdomen.

With respect to the cure of lead palsy, an endless variety of treatment, both local and general, has been tried, but with so little positive result, that when the patient has recovered it has been doubtful whether it has been owing to the great length of time that has elapsed, or to the medicines he has been taking. There is only one medicine that appears an exception to this rule, and that is the ergot of rye (secale cornutum), and there is some hope that this is a specific for the disease in doses of gr. x. ter die. As far as it has been tried, it produces a considerable increase in the power of the flexor muscles of the arm in about a fortnight, and the improvement gradually extends to the flexors till at the end of about three months the patient has recovered. Supposing this medicine to prove a specific, in what manner does it act? Is it by imparting increased power to the nerves, or by combining with the lead incorporated in the muscular tissues, and rendering it more readily absorbable? The experiments of Orfila render it probable that lead is removed from the body by the kidneys, for on carbonizing a portion of urine of a young girl who had taken about an ounce of acetate of lead with an intention of commiting suicide, and treating the residue with nitric acid, and submitting it to the usual tests, he obtained a sensible portion of lead, showing that the kidneys are one of the means by which this metal is removed from the body.

Fish Poisoning.

The subject of fish poisoning is one of the most singular in the whole range of dietetics. Many persons have an idiosyncrasy so peculiar that even cod or salmon will produce an eruption or other temporary disease. It is well ascertained that the oyster, and still more the muscle, at times acquires properties which render it poisonous or hurtful. Vancouver had four sailors taken ill, after eating muscles, of whom one died in five hours and a half. Two fatal cases also from the same cause occurred in the practice of Dr. Combe.

It has been thought that the muscle might acquire its poisonous qualities by feeding on a bed of copper, but Dr. Christison analyzed some muscles taken from the stomach of Dr. Combe's patient without finding a trace of copper; and subsequently it was ascertained that, so far from feeding on copper, the muscles in question had been taken from some Memel fir logs which had lain at the mouth of the harbour for fifteen years. The particular poison, therefore, must be an animal poison acting on a peculiar temperament.

The symptoms which poisoned muscles give rise to are great pains in the stomach, some fever, and a very general erythematous eruption; some also are said to suffer from coryza, and others from peritonitis, and these symptoms last for a week or ten days.

The treatment of poisoning from muscles is generally an emetic, and often bleeding and other rough treatment. It is singular, however, that the most efficient remedy is to drink copiously of milk. In what manner milk acts is uncertain; some imagine that the poison is mechanically entangled in the coagulum, and thus more easily brought under the action of digestion. The more probable mode, however, is, that the poison becomes chemically combined with the caseous portion in the same manner as corrosive sublimate unites with albumen, and is thus in a great measure rendered harmless. Whatever be the *modus operandi* of milk, it is certain that in a few hours the patient is relieved, and, by attention to the bowels, speedily recovers.

Besides fish poisoning, three common articles of food have often produced death in Germany, as sausages made a long time, and of meat that has been boiled before being salted and hung up; also old cheese and rusty bacon. Dr. Kerner has determined the poison of the sausages to be an acid formed in consequence of a modified process of putrefaction. Dr. Daun, however, affirms it to be the empyreumatic oil. Old cheese is supposed to be poisonous from the conversion of the curd or caseum into the caseate of ammonia, the caseic acid being said to be so poisonous that a drachm and a half procured from cheese killed a cat in eight minutes. The poison of rusty bacon is said to be sebacic acid and an acrid oil. Meats thus prepared are often sensibly obnoxious to delicate stomachs at a much earlier period of decomposition than is here pointed out. Thus many persons are unable to eat French pâtés, however delicately flavoured. The mode of treating the diseases caused by these poisons is not determined.

Of the Neuroses of the Liver.

The liver is the largest organ of the body, and has been found to weigh, in the healthy adult, from two to five pounds. It receives nerves from the eighth pair, thus putting it under the influence of the passions. Its office is to secrete bile, a fluid which all physiologists have considered of the first importance in the animal economy. What, however, is the peculiar purpose of bile is not determined; some physiologists consider it as subservient to digestion, and others that it is an excrementitious matter separated from the blood and removed by the alimentary canal, while others affirm that it acts as a natural tonic to the intestines, and regulates, perhaps, both the absorption of the chyle, and also the peristaltic motion. The neuroses of this organ are jaundice and gall-stones.

Icterus, *Jaundice*, the *Yellows*, is the absorption of bile and its circulation with the blood, whence many of the different tissues and fluids of the body become dyed yellow, but more especially the conjunctiva and the cutaneous tissue, for which the bile appears to have a great affinity.

This disease was known to Hippocrates and to all succeeding writers. The term *icterus* is said to be derived from the complexion of the jaundiced person resembling the golden thrush, and by looking on which, like the Israelites of old on the brazen serpent, it was supposed the patient would be cured. Another odd term is *morbus arquatus*, from bad cases of jaundice presenting almost as many and as varied colours as the rainbow. 800 cases of this disease died in England and Wales in 1839.

Remote Cause.—The bile, although constantly secreted, is only poured into the duodenum at the time when digestion is going on, being in the interval received into the gall-bladder. Any defect, therefore, of that sympathy which exists in health between the duodenum, the gall-bladder, and hepatic ducts may cause the bile to be retained and the patient to be jaundiced. Among the causes of jaundice, therefore, may be enumerated every functional or structural disease of the stomach and duodenum, and also of the liver itself; and among the causes of the diseases of the latter organ, the paludal poison and excessive indulgence in ardent spirits may be mentioned as the most prominent. Mechanical causes also occasionally produce jaundice, as an enlargement of the head of the pancreas, or an aneurismal or other tumor pressing on the *ductus communis*. Dr. Young gives a singular case of jaundice in which a hydatid had got entangled in the *ductus communis*, and completely obstructed the passage. In this case the liver adhered to the diaphragm, and the diaphragm to the lungs, and an abscess formed, so that all these parts communicated with the bronchi, and pus and bile passed into the lungs, and was thus absolutely spat up by the mouth. Pregnant women are also often jaundiced, and as is supposed from pressure of the uterus.

As the brain is put in communication with the liver by means of the eighth pair, the passions often produce jaundice. A woman was upset in a boat on the Thames, and the next day she was jaundiced. An untoward accident threw a lady into a violent passion, when in a few hours she was jaundiced. A medical gentleman is mentioned by Mr. Cooke who became jaundiced every time he had a difficult case under his care, and a young man is stated by Morgagni to have become jaundiced from having a gun pointed at his breast.

Predisposing Causes.—New-born infants are liable to jaundice, and it may occur at any subsequent age. It is most common in the heyday of the passions, or between 20 and 40. Women are supposed to be more liable to this affection than men. In some few instances jaundice appears to run in families, for Mr. Pearson speaks of a family of 17 children, of whom 10 had died shortly after birth of jaundice, and another about six years old.

Pathology.—Jaundice, though often a result of every organic disease of the liver or duodenum, yet often occurs when those organs are perfectly healthy, and is consequently in many cases merely a disease of function. On posthumous examination, besides the yellowness of the cutis, the serum of the blood is generally found loaded with bile and perfectly yellow; and in one case of *icterus arquatus*, singular to say, though the patient was yellow, yet the serum of the blood taken by cupping was green, and from which, nevertheless, the albumen, on the addition of nitric acid, was thrown down yellow. If the disease is at all chronic the fat is also yellow, as well as the bones and cartilages. All the serous fluids are likewise yellow, and even the milk is said to be expressed yellow from the breast of a suckling female.

The theories that have been formed to account for jaundice, are, that the bile exists formed in the blood, and is merely removed by the liver, and consequently jaundice is a consequence of the non-separation of the bile. A more common opinion is, that bile is a secretion and not a separation, and consequently that in jaundice the bile is first secreted and then absorbed both by the veins and lymphatics, while Portal has proved that it may be absorbed in a third manner, or by the lacteals. Every attempt to prove by experiment whether bile is secreted by the arteries or veins has been either unsatisfactory or has failed; but reasoning from the structure of the liver, and that the portal vein ramifies after the manner of an artery through this organ, most physiologists have concluded that this latter vessel is the great secreting system of the bile.

Symptoms.—Jaundice, from the different intensities of the colour of the skin, has been divided into the yellow, the green, and the black jaundice.

Jaundice, arising from functional disease, may be sudden in its attack, or it may be preceded for a few

days by great depression of spirits, lassitude, and somnolescence. It may also be preceded or accompanied by some slight pain in the region of the liver, but more commonly pain is not present.

The first symptom of jaundice is a yellowness of the white of the eyes, then of the roots of the nails, or of that part termed "the half-moon;" the yellowness next appears over the face and neck, and ultimately over the trunk and upper and lower extremities. As soon as the eyes are affected the urine becomes of a deep red colour, and stains linen steeped in it yellow, and if nitric acid be added it is changed to a deep green. The bile, however, is not always in the same state of combination in the urine, or else not of the same quality; for, in some instances, where the colour of the patient is most marked, and the urine of its deepest hue, the addition of nitric acid effects no change. At the same time the urine is thus discoloured, the stools, often abundant in quantity, are copious and white. The pulse is slow, and the patient complains of a bitter taste in the mouth, has much thirst, an absolute inaptitude to all exertion, and suffers from a lowness of spirits, amounting to hypochondriasis. In general the bowels are irritable and easily acted upon; but, in a few cases, they are constipated. If the patient recovers, the first symptom is the appearance of bile in the stools, and after this the yellowness fades away in the inverse order of the attack, or first from the legs, trunk, chest, face, and, lastly, from the eyes; and in proportion as the yellowness disappears from the body the bile in the urine decreases, till at last it disappears altogether. On the contrary, if the patient falls, his death is generally preceded by delirium or dropsy.

The duration of this affection is very various. In some cases it terminates in about ten days, but more generally it lasts from three to six weeks, and, if badly treated, oftentimes as many months.

As the serum of the blood is yellow, and all the serous secretions are occasionally yellow, even to the semen and saliva, we can hardly feel surprised that Dr. Cheyne should mention the linen being sometimes dyed yellow by the perspiration; neither can we feel surprised that, to the jaundiced eye, "all things seem yellow." The patient, however, more commonly possesses his natural sight, and only in a few instances "sees yellow." Dr. Pemberton saw this phenomenon but twice. Dr. Elliotson also gives but two cases, or one in which the patient saw yellow with both eyes, and one in which he saw yellow with only one eye. The cause of this has been supposed to be the discoloured yellow serum circulating through the lenses and coats of the eye, or else that the aqueous humor must be tinged with the bile. The latter was examined in one case of a patient that saw yellow, but the colour of the humor was natural.

Diagnosis.—This disease is to be distinguished from chlorosis and that sallow state which results from profuse uterine hæmorrhage. In these complaints the white of the eye is blue, the urine limpid, and the stools healthy, so that the great characteristics of jaundice are wanting.

Prognosis.—In those cases of jaundice in which no mechanical obstruction or organic disease exists, the proportion of recoveries to deaths is large. Indeed, the restoration of the patient is almost certain. On the contrary, when it results from organic lesion, the death of the patient is much more usual than his recovery.

Treatment.—As a general principle, the larger number of cases of jaundice from functional disorder, perhaps four out of five, will get well on very trifling remedies. Two cases recently in St. Thomas's Hospital recovered by taking merely ℈j. of the carbonate of soda ter die, while two other cases recovered by taking the sulphate of magnesia ʒ ſs. to ʒj. with tinct. hyoscyami ♏ xv. out of camphor mixture, also three times a-day, and similar cases would perhaps do equally well on small doses of rhubarb or of castor oil.

It was formerly the practice to treat almost every case of jaundice by mercury; and, 30 years ago, hardly a case was admittted into St. Bartholomew's Hospital that had not been previously salivated, a circumstance which shows the extent to which this medicine has been tried, and that its exhibition is not by any means uniformly successful in the cure of this disorder. It is observed, also, when mercury fails, its effects are in many cases decidedly injurious; for a common jaundice is often turned into a black or green jaundice, which are the worst cases we meet with. There are a few cases, however, but perhaps not more than 1 in 9 or 10, in which the jaundice resists all other remedies, and yet is cured by mercury given in moderate doses, either of blue pill or of calomel, till the gums are sore. But the particular case is not to be distinguished by any peculiarity either in the history or symptoms from those that readily yield to more simple remedies, with only one exception, or the persons who almost live in a mercurial atmosphere, as the nurses of the foul wards, and these are often attacked with jaundice, and are only cured by the use of mercury. There is another class of jaundice, or that from ague, which readily yields to mercury, but, in case after case, resists a treatment by neutral salts.

As the cases which require mercury are few in number, it is desirable, in every instance, to treat every patient for 10 days or a fortnight with neutral salts, not only as offering the greatest number of chances of recovery, but also as sparing the larger number the unnecessary miseries of salivation. At the end of a fortnight, if no improvement be visible, it is then desirable to exhibit greater or less doses of mercury. In general five grains of blue pill once or twice a-day are sufficient, combined with some slight opiate.

There are cases which will not yield to the neutral salts ordinarily in use, and are only partially relieved by mercury; and in these instances the manganesii cum ammonio-sulphatis ʒ ſs. to ʒj. ter die, has often cured the patient when the preceding measures have failed.

In many cases the modes of treatment which have been mentioned are rendered much more beneficial if combined with some light vegetable or mineral tonic, as the infusi aurantii, cum tinct. aurantii ʒj. to ʒ ij., or else the tartrate of iron, 5 to 10 grains, may be added to each dose. The mineral waters of Cheltenham and Leamington, in which a neutral salt is naturally combined with iron, are known to be excellent remedies in most cases of jaundice.

Many practitioners make a practice of bleeding or cupping in almost every case of jaundice, a mode of treatment for which perhaps no sufficient reason can be alleged, for pain is seldom present, or any symptom to warrant it. It is a maxim, however, with Mr. Hill, in cupping jaundiced patients, not to cut deep; for although little blood flows in general while the cupping-glass is on, yet, shortly after it is removed, hæmorrhage often

takes place, and there is great difficulty in stopping it. One patient in St. Thomas's Hospital recently died from this circumstance.

The diet of the jaundiced patient should be light; fish, puddings, and slops should be substituted for meat and poultry, and this abstinence should be persevered in till the patient is well.

Of Gall-Stones or Hepatic Calculi.

Human bile has been analyzed by many modern chemists, and especially by Thenard, Berzelius, Vauquelin, Vogel, and Chevreul, but they have all arrived at different results. That by Berzelius is the most received, and is as folllows:—

Water	907·4
Biliary matter	80·0
Mucus	3·0
Salts	9·0
	999·4

Or, according to Thenard, it consists of—

Water	700·0
A green resinous matter or peculiar principle	15·0
Picromel	69·0
Salts	17·5
	801·5

In its healthy state it is of a deep yellow colour, extremely bitter, a little heavier than water, and miscible in that fluid in every proportion; and that in the gall-bladder is usually of the consistency of thin molasses. As it contains a little free soda it is alkaline, and its solid contents principally resolvable into a very large proportion of carbon and a small quantity of azote.

This fluid is liable to undergo many morbid changes; thus it is found green or yellow, and those colours may be pale or intense; or it may be as fluid as water, or as viscid as tar. Its taste is also greatly affected, it being sometimes bland, and at others so acrid as to excoriate the lip. These different states do not denote different states of the liver; for the same condition of bile is found in the most oppositely diseased states of the liver, so that they must be looked upon chiefly as resulting from diseases of function. The most remarkable, however, of the states of diseased bile is that in which it concretes into a gall-stone. The disease was known to the ancients, but the chemical composition of these calculi has been determined by the labours of the moderns, or by Fourcroy, Poultier, Powel, Chevreul, and others.

Remote Cause.—The remote causes of this disease are supposed to be too full an animal diet, combined with a sedentary life, or the indulgence of anger or of those other passions which suppress the flow of bile, and perhaps alter its qualities; also those states of indigestion which re-act on the liver. This affection, however, is not necessarily connected with ill health, for calculi have been found in the gall-bladder of persons who have died accidentally, and apparently in the best health.

Predisposing Causes.—This disease appears to be peculiar to adults; generally occurs after 20, but is, perhaps, most common between 40 and 60. It is supposed to affect women rather than men, and persons of sedentary rather than those of active habits of life.

Pathology.—Biliary calculi are often found filling the gall-bladder when the structure of the liver and gall-bladder is perfectly healthy; they are, therefore, a consequence of functional disease. Their principal seat is the gall-bladder, but they have been found "*in transitu*" in the cystic duct and in the ductus communis. Occasionally they have been found in the hepatic ducts, but so rarely that this fact is very generally doubted. Cruveilhier, however, has given one instance in his very splendid work on pathological anatomy, and Ruisch another. Lastly, they are sometimes found in the intestinal canal, after having passed from the gall bladder into that cavity.

Although the liver is frequently found healthy when the gall-bladder contains calculi, yet more commonly perhaps its structure is more or less diseased, and the lesion may be of every description to which that viscus is liable; thus it may be harder or softer, granular, or otherwise diseased. In some instances the ductus cysticus is obliterated, in others the gall-bladder is thickened or ulcerated; and if the body be examined shortly after a large gall-stone has passed into the intestine, the ductus communis, so small in health that it is difficult to find it, is then so enlarged as to admit the finger. In some very rare instances the extremity of this latter duct has been found obliterated from inflammation, in consequence of the irritation to which it has been directly or indirectly subjected.

The modern chemists have determined that gall-stones are composed principally of two substances, cholesterine and colouring matter, in various proportions, together with some animal matter, the usual salts, and perhaps a trace of iron. Cholesterine, which sometimes exists in the large proportion of 88 to 94 per cent. of the whole calculus, is soluble in boiling alcohol, æther, and in nitric acid. It is tasteless, inodorous, and burns by the flame of a lamp till it is altogether consumed. It is also lighter than water, and insoluble in that fluid. Its constituent elements give it much resemblance to ambergris, and are—

	Cholesterine.	Ambergris.
Carbon	72·000	84·088
Oxygen	6·666	2·914
Hydrogen	21·340	12·018
	100·	99·020

The colouring matter, also, which is generally combined with the cholesterine, and often forms of itself a large portion of the gall-stone, is inodorous, insipid, and heavier than water. It is likewise insoluble in that fluid, in alcohol, or in acids, but is soluble in alkalies, whence it is precipitated, on the addition of water, of a brownish green colour.

The calculi found in the human gall-bladder have been divided by Dr. Powel into crystallized, deposited, amorphous, and porcupine calculi.

The *crystallized* concretions, when fractured, look like spermaceti, and the crystals, like those of that substance, are easily broken into a sort of greasy powder. They are in general semi-transparent, but seldom retain their purity throughout, being, near their circumference, coated or mixed with more or less of a brown colouring matter. At the central point of these colourless crystals, to which the radii converge, there is mostly a small particle of coloured matter, resembling dried bile, and which has served apparently as the nucleus of crystallization. Sometimes this crystallized shoot, having

Elementary Principles of Medicine.

reached perhaps the size of a pea, becomes itself a centre around which many depositions are afterwards made of various confused and irregular strata, and the surface of these strata may in their turn become the nucleus of a fresh crystallization.

The *deposited* gall-stone is a deposition of biliary matter in laminæ, like the arrangement of an onion or of an urinary calculus.

The *porcupine* calculi are small round calculi, having a number of projecting points, and hence termed porcupine calculi. They are generally small, and their structure has not been determined.

The amorphous concretions are such as bear no mark of crystallization, or of any very regular structure, but sometimes as they dry they break into layers, showing their mode of formation.

Biliary calculi vary considerably in their specific gravity; and this does not appear to depend on any peculiarity of structure; for, two of the purest specimens being selected, one swam while the other sank in water —a difference perhaps owing to the greater or less quantity of animal matter they may contain.

These calculi vary greatly in number, or from 1 to 1000. When single they are usually of a round or oval figure. In size they vary from a pin's head to that of a nutmeg or a walnut; and Dr. Baillie has seen one as large as a hen's egg. When extremely numerous, they are usually small, of a dark brown colour, and occasionally slightly agglutinated with viscid bile. When, however, the number is small, or from two, three, to eight, the size often is considerable, and in this case the gall-stone is often made up of several, loosely adapted or fitted to each other, showing they must once have existed in a soft state.

With respect to the formation of gall-stones, the cholesterine, not being a constituent of healthy human bile, is evidently a morbid product, and is secreted in a fluid state. From this, if a nucleus of any kind, as a piece of thick mucus, be present, crystals may immediately shoot or form upon it; and thus a person apparently in good health may in an instant have a large gall-stone formed in his gall-bladder. Dr. Powel thinks he has met with cholesterine in a fluid state in the gall-bladder of a patient he examined. The peculiarity of this bile was its remarkably deep and almost black colour, whence he was led to treat it with alcohol, and in this manner he obtained solid cholesterine. The deposited gall-stone must be formed by an excess of colouring matter, or else by some morbid state of the bile, in which that principle is readily separable when any nucleus is present.

Symptoms.—The formation of the gall-stone is unattended with pain, and the stone, once formed, often lies latent for a considerable time. At length, however, some cause forces it into the cystic duct, when a series of very formidable symptoms arise, and which continue till the calculus has passed into the duodenum.

The attack is generally sudden, the patient being seized with shivering, accompanied by violent and acute pain at the pit of the stomach, or rather at the point corresponding to the opening of the duct into the duodenum, and from this point it darts through the back. This pain occurs in paroxysms, varying from a few minutes to a few hours, when it intermits, and after a short interval returns, and this continues till the gall-stone has passed into the intestine. The patient during this trying period suffers from nausea or vomiting so severe that everything is rejected, and the matters thrown up often contain bile and small biliary calculi.

Pains and vomiting are the leading features of the passage of a gall-stone, and it is impossible for those who have witnessed it not to be struck with the resemblance many of its symptoms bear to those of parturition—a comparison women frequently make when describing their sufferings. There is this difference, however, that when the pain intermits there is a deep-seated soreness and fulness of the right hypochondrium and epigastric regions. Like parturition, then, one attack of pain succeeds another, till at length this more urgent symptom ceases, and the calculus may be inferred to have passed into the intestine. After that has taken place, the soreness and uneasiness gradually cease, and the patient is restored to health. In some cases, and at some early period of the attack, jaundice makes its appearance, and continues for a considerable time after the calculus has passed.

The pulse during the paroxysm is for the most part natural, unless the patient is exhausted by long continuance of pain. The heat of the body also is often increased, but it is not the heat of fever. The dejections, according as the obstruction is more or less complete, are clay-coloured or natural, and, by a close examination, are ultimately found to contain the offending calculus.

The duration of the attack is very various, sometimes only a few hours, sometimes a few days, while sometimes several weeks elapse before the gall-stone is expelled.

It has been imagined that the degree of angularity of these concretions must considerably influence the symptoms; this, however, is not the case, for their angles are never sharp enough to cut nor their points to pierce. Size is of more importance than shape, and in proportion to its magnitude so will be the opposition to its passage. The transit of one concretion, by distending the duct, necessarily facilitates the passage of a second.

The symptoms which have been described are the most usual, but sometimes they are exceedingly anomalous. In one case, a lady was seized with violent pain in the left shoulder, similating rheumatism. She then fell into a state of somnolescence so complete that even on the night-stool she slept and was obliged to be held. This state lasted for a fortnight, when she was seized with violent pains in the right hypogastrium, and, after some days, passed a gall-stone as large as an olive.

The symptoms which have been stated as a general principle cease on the gall-stone passing into the duodenum; but sometimes the calculus is so large as to give rise to severe disorder of the intestinal canal. A lady was attacked with symptoms of ileus, which gave rise to a suspicion of hernia, and an operation was about to be performed, when the patient most unexpectedly passed a stool in bed, which came away with a report like a pistol-shot. On examining the matters passed, a biliary calculus was discovered, $1\frac{6}{10}$ of an inch in length and $1\frac{1}{10}$ of an inch in diameter; it weighed 228 grains. The lady recovered.

Diagnosis.—The passage of the gall-stone is to be distinguished from hepatitis by the pains being in general of great intensity, and relieved by pressure, and also by the pulse continuing natural.

Prognosis.—The prognosis is always favourable,

unless the calculus be of such magnitude as to render its passage almost impossible, or unless it be connected with organic disease of the liver.

Treatment.—When the symptoms of gall-stone passing the duct are present, the curative indications are to facilitate its passage into the intestine, to relieve the intense pain which accompanies it, and to prevent that inflammation which the presence of an extraneous body of any magnitude is calculated to produce in the duct.

The first thing to be done is to calm the sufferings of the patient, and a grain of solid opium, or a grain of morphine, or, what is still better, the mistura camphoræ, ʒ xj. conf. opii ʒ fs. to ℈ ij. c. sp. æth. nitr. ʒ j. should be given every hour or every two hours till some relief is obtained, and then exhibited every four or every six hours till the pain has ceased. Should the bowels be constipated, a drachm of the sulphate of magnesia may be added to each dose, or the bowels may be emptied by an enema of warm water, salt and water, or other medicament. If the vomiting be severe, and the above medicines be rejected, the opiate should be exhibited out of an effervescing draught.

Besides these medicines, a warm bath should be immediately prepared, and the temperature should be as high as 100° to 110°, or indeed as the patient can well bear it, and the immersion should continue till he is in some degree exhausted. The intention of the bath is to relax by means of heat the muscular fibre of the ducts, and thus relieve the pain and facilitate the passage of the gall-stone. Whether this theory be correct or not is unimportant; but the effect of the bath is always so agreeable to the feelings of the patient that, on the recurrence of the pain, he constantly asks for a repetition of it, and his wishes should be complied with. If a warm bath cannot be procured, fomentations, or a large linseed poultice should be applied over the abdomen. Dry heat is always at hand, and hot flannels, hot sand, or hot camomile flowers afford some relief.

Bleeding is supposed, during the passage of a gall-stone, to be injurious; for, by debilitating the muscular fibre, it is rendered more irritable, and consequently its contraction is irregular, morbid, and prolonged. It is a rule, therefore, not to bleed until the gall-stone has passed the ducts. When that is effected, if the side be extremely tender, and apprehension be entertained that the duct may have inflamed in consequence of the irritation it has suffered, a few leeches to the side, or a few ounces of blood taken by cupping are admissible, but this practice is rarely necessary.

The calculus having passed, and the patient being relieved, the secretions of the liver should, if possible, be rendered more healthy; and a short course of neutral salts, or of the Cheltenham or Leamington waters, or small and occasional doses of blue pill or of calomel, should be recommended as a means of rendering the secretion of bile more healthy; also, if the patient be of sedentary habits, he should be induced to take more exercise. Diet also has a considerable influence on the character of the bile. Children, from their simple diet, do not appear to suffer from this disease; and a simple diet, consisting of less animal matter and of smaller quantities of fermented liquors, should be adopted. Nothing can show more strikingly the effects of diet on the bile than by stating that when animals are fed on madder the bile is of a brighter tint, or if fed on sugar, that it approximates to that of herbivorous animals.

Of the Neuroses of the Organs of Respiration.

The diseases of function of the respiratory organs are, spasm of the epiglottis and glottis, aphonia, spurious croup, asthma, fœtid breath, and emphysema of the lungs.

Strangulatio, or spasm of the epiglottis and glottis, is a sensation of choking, more or less violent, preventing the introduction of air into the lungs.

Remote Cause.—Whatever causes an abnormal state of the muscles of these parts is a remote cause of this affection; thus the apoplectic patient has often died when eating from the food in his mouth pressing on the epiglottis—a mode of death not uncommon in the insane. Spasm of the glottis is a frequent symptom of hysteria, as may be seen by the patient constantly grasping the throat. It also occurs in children during the period of dentition, causing cerebral croup. Every structural disease of the larynx is a cause, as may be seen by the laborious breathing of the parties affected. Sometimes it is obviously the effect of the accidental admission of a particle of salt or of grease into the larynx, or other foreign body, as a bead or bean, a pebble or a shell, a fish bone, a button mould, a portion of a nut-shell, the stones of fruit, &c. The phenomena produced by these latter causes are so remarkable that we shall shortly trace them.

Pathology.—When a patient has fallen after a foreign body has passed into the trachea, the phenomena vary in some degree according to the size of the object and the duration of the disease. If the patient has fallen within a few days after the accident, the body, if small, is usually found in the ventricles, gripped by the chordæ vocales; and besides this little else is to be seen except a quantity of mucus and a slight redness of the bronchial membrane. In cases of longer duration, and especially when the body is large, it has in general been found in the right bronchus, for a line let fall perpendicularly from the centre of the larynx falls into that tube. In addition to this, more or less of inflammation has been found, sometimes ulceration, by means of which the foreign substance has occasionally made its way into the lung, and the patient has died of pneumonic abscess.

Symptoms.—The introduction of the foreign body into the larynx is always the result of accident, the substance being carried forward to the glottis by the act of laughing or crying, or else by the current of air in a strong inspiration. The first symptoms are an instantaneous sense of suffocation, the person or child becoming black in the face, and this is accompanied by a violent cough. This lasts till the patient is entirely exhausted by the effort of the lung to rid itself of this foreign substance. A calm of necessity follows, and the substance falls down into the bronchi, where it remains quiescent till the sensibility of the parts again accumulates and a fresh effort is made to throw off the offending cause, an effort so convulsive that it is difficult to conceive without witnessing it. It is singular how long an interval will sometimes take place between the paroxysms. In a recent case the little patient appeared quite well, played about, eat heartily, and slept soundly for a whole fortnight, when the fatal attack fixed the substance (a shell) in the ventricles, and carried him off. The fatal period, however, is often much longer delayed. Mr. Liston removed a fragment of a bone six months after it had been swallowed; while

Mr. Sere speaks of a girl who coughed up the rump-bone of a chicken seventeen years after its introduction. Besides the severity of the paroxysm there is little else to denote this accident. In a late case (Mr. Brunel's) the stethescope gave no indication; and it will be plain, if the substance be of such magnitude as entirely to stop up the bronchus, air will be retained in the lungs, while, if it be smaller, air will still pass upwards and downwards, so that the lung will still give a healthy sound on percussion.

Diagnosis.—The difficulty of forming a diagnosis has already been stated.

Prognosis.—The danger in these cases is very great, from the fatal consequences which may follow a sudden return of the paroxysm. In a few cases only is the patient saved by coughing up the foreign body.

Treatment.—The treatment is by emetics, or substances that occasion violent sneezing, in hopes that the efforts thus occasioned may cause the expulsion of the foreign body. If this, however, should not take place after once or twice exhibiting these substances, tracheotomy should be performed, for, supposing the diagnosis to be erroneous, the operation is trifling and void of danger, while, if the foreign body be present, it is in general easily extracted; or should any difficulty occur in its removal, the case of Mr. Brunel shows that it may escape by its own gravity, by fixing the patient to a board and holding him up with his head downwards.

Spasmodic Croup.—*False croup* is a spasmodic affection of the larynx and glottis, by which a sudden hoarseness and difficulty of breathing, resembling the most aggravated symptoms of inflammatory croup, is produced. This disease, however, seldom lasts more than a few hours, when it subsides.

Remote Cause.—This affection rarely occurs except in children, and generally only after exposure to a cold easterly wind, or else after eating a very large, heavy, indigestible meal.

Predisposing Causes.—Every recorded fact seems to show this disease to be extremely rare, except in children under six years of age.

Pathology.—This disease seldom proves fatal, and the sudden subsidence of its formidable symptoms demonstrate it to be merely a disease of function.

Symptoms.—The symptoms are, that the child is on a sudden seized with a hoarse, crowing, sibilous breathing, loudest on inspiration, when his face becomes full and red or purple. The great distress of the child is manifest, but the pulse is quiet, and when proper remedies are applied it generally subsides in a few hours. The ratio symptomatum, when the disease occurs from indigestion, is, that the stomach being overloaded, the irritation of the gastric branch of the eighth pair is propagated to the laryngeal and pulmonary branches, and causes the difficulty of breathing.

Diagnosis.—Spasmodic croup may be distinguished from inflammatory croup by the suddenness of the attack, the quietness of the pulse, and the temporary duration of the disease.

Prognosis is always favourable.

Treatment.—In those cases in which the disease arises from sympathy with the stomach, an emetic is the best remedy; a drachm, therefore, of antimonial or of ipecacuan wine should be exhibited every quarter of an hour till vomiting is produced. As soon as the stomach is emptied the spasmodic breathing is relieved, and the paroxysm gradually subsides. The further treatment is to purge the child and put it on a light diet for a few days. When it results from a cold wind, the warm bath and free purging in general speedily restore the little patient.

Aphonia is when the larynx is so affected that the voice is wholly or partially lost, so that the patient is unable to speak except in a whisper.

Remote Causes.—The remote cause of primary aphonia is whatever affects the muscles of the larynx, as any overstraining of the voice in singing or speaking; cold or sudden changes of the weather; rheumatic affection of those parts is also a cause, as likewise all that impairs the nervous energy of the laryngeal muscles. Thus the voice is often lost after a paroxysm of hysteria or a severe mental affection. It is well known, also, that at the period of menstruation public singers lose two or more of their upper notes.

Predisposing Causes.—Complete aphonia is common to all ages, but is most common in early adult age, and more particularly in the female. In advanced age the change of the voice, and the general impairment of its tone and volume, is well known. Many singers who have compassed two octaves in their prime hardly perhaps preserve four feeble notes in old age; but this, perhaps, among other changes, may be owing to ossification of the cartilages.

Pathology.—An entire loss of the voice often takes place without any congestion, inflammation, or other structural lesion of the tissues of the larynx and glottis, and is therefore essentially a functional disease. When aphonia is secondary or symptomatic, tubercular or other structural diseases of the lungs are often found.

Symptoms.—In primary aphonia there is no tenderness or soreness of the larynx, no pain on pressure, and no expectoration, and the general health of the patient is good. It often comes on suddenly, and only in a few instances is the attack gradual. It often also disappears in a few hours, but in other cases it continues for some weeks and even months.

Diagnosis.—Aphonia is so marked a symptom, that though some doubt may exist as to the cause, none can exist as to the disease. It is distinguished from the aphonia in phthisis by the general good health of the patient.

Prognosis.—Primary aphonia is seldom of any moment. When it results from phthisis it is one of the fatal symptoms.

Treatment.—Primary aphonia, though a disease of little consequence, is often very difficult to cure. Sometimes attention to the general health will remove it. In other cases it yields to some local application, as blisters, mustard poultices, or the linimentum camphoræ, or other stimulating application. Dr. Elliotson sums up what can be done in these cases as follows,—"I do not know any better mode of treatment than the shower bath and attention to the improvement of the general health in every way you can." It should be remembered that this disease can be easily feigned.

The functional diseases of the lungs are asthma, fœtid breath, and emphysema.

Asthma.—Asthma is a laborious wheezing respiration, for the most part occurring in paroxysms, or, if constant, having exacerbations and remissions. 5183 persons are said to have died of this complaint in 1839 in England and Wales.

Remote Causes.—Whatever irritates the muscular fibre of the bronchial tubes, or impairs their nervous energy, or affects the secretions of the bronchial mem-

brane, may be a cause of asthma. Every act of intemperance, either from accelerating the circulation, or from the sympathy which exists between the gastric and pulmonary branches of the eighth pair, is a cause. Every mental affection, also, either from acting on the heart, or from its exhausting the system generally, and consequently the lung of its nervous energy, is also a cause. Laënnec speaks of a man who, probably from apprehension of an attack, could not ride across a plain. Temperature or weather has also a great influence in the production of this disease. Floyer says, a change from frost to thaw often caused him a paroxysm; also a change of wind from west to east. Rain, or snow, or fog, often had the same effect; and "I feel them," he adds, "even before they come on." He states, also, that he suffered sixteen attacks in winter and twenty in summer, but that the most violent paroxysms were in August. Van Helmont says, he has also observed asthma to be more frequent and more severe in summer than in winter, but adds, "I have likewise seen asthmatic patients who suffer more in winter than in summer." Indeed the asthmatic patient may be said to be—

> "But now of turbid elements the sport,
> From clear to cloudy toss'd, from hot to cold,
> And dry to moist, with inward-eating change,
> Our drooping days are dwindled down to nought—
> Their period finish'd ere 'tis well begun."

Sometimes asthma arises from inexplicable conditions of the air: thus, most people are better in the country; but some can only live in London in the narrowest and darkest streets; others are well in low and damp situations, surrounded by the smoke of steam-engines and the effluvia of lime-kilns; while others can only breathe on a high, open, and dry position. Again, asthma is often caused by some specific irritating cause. At St. Thomas's Hospital, the laboratory man cannot pound ipecacuanha without being seized with a fit of asthma which lasts him many days; while the smoke of tobacco, or the emanations from grass in flower, producing what is termed hay-fever, or hay-asthma, are causes of it in others. The impalpable dust inhaled by bakers, miners, leather-dressers, china manufacturers, or needle grinders, is often a cause. Every structural disease of the lung is also a cause, and asthma is consequently an occasional accompaniment of phthisis.

Predisposing Causes.—This disease sometimes occurs in children under ten years of age, but these cases are extremely rare. It is not unusual between twenty and thirty, but is most common after fifty. Women in this country suffer in a less proportion than men, 3092 having fallen of the latter to 2091 of the former. Frank, however, says in his experience, that males suffered more than the females in the ratio of six to one. In young women the attack is most severe about a week preceding menstruation. The aged, indeed, of either sex, are seldom altogether free from it, and this appears to be chiefly owing to the physiological changes which take place at this period of life, the tissue of the lung becoming more rare, its cells larger, and its capillary blood-vessels obliterated; while the innervation of the eighth pair is very generally impaired, and thus the foundation of the disease is laid in organic alterations. Asthma appears in many instances to be hereditary, and to descend through two or three generations.

Pathology.—In proof that this affection is merely a disease of function, the bodies of many persons have been examined without the lungs being in any sensible degree diseased. Persons, however, affected with this complaint have in general very delicate lungs, and suffer much from bronchial inflammation, and the mucous membranes are consequently often congested. The cough is also often of unusual violence in this disease, and the lungs are therefore sometimes found emphysematous. In the aged, asthma is very constantly combined with disease of the large arteries, and more especially with disease of the left side of the heart, and in this latter case the asthma in all probability arises from the sympathy which exists between the cardiac and pulmonary branches of the eighth pair.

Symptoms.—Asthma has been divided into three kinds, or into dry asthma, humoral asthma, and purulent asthma; but these different forms of disease run very constantly one into the other. In general it is paroxysmal, but sometimes it is continued.

The dry asthma is a continued difficulty of breathing, with a loud wheezing respiration, increased by every attempt at bodily exertion, but without any affection of the mucous membrane of the lungs. This disease is common to old people, especially those whose heart and arteries are affected; and the difficulty they experience in walking or in ascending a flight of stairs, "for want of breath," is well known. More commonly, however, the mucous membrane is affected in asthma either with an abundant serous expectoration, or else with a more or less copious secretion of pus; but in either case the peculiar symptoms of asthma are not changed. Floyer, who laboured under this disease for thirty years, thus describes his sufferings during the paroxysm.

"For some hours preceding the fit of asthma, the patient experiences a sense of straitness, a fulness about the pit of the stomach, and is much troubled with flatulency; at the same time there is a heaviness of the head, drowsiness, propensity to yawning, and a discharge of pale urine. If these symptoms come on towards the afternoon they are followed at night by a tightness straight across the chest, and oppression of the breath and some wheezing. There is generally, too, convulsive cough, with little or no expectoration. In the course of the night the symptoms become more urgent, the inspirations are made with the utmost labour, the chest and shoulders being lifted up with great violence, and in a convulsive manner. In this distressing state the patient is often necessitated to get out of bed and to remain in an upright posture. Although the expirations are not so difficult as the inspirations, yet they are performed very slowly and with a wheezing noise. In this stage of the fit a person can neither speak nor cough. His face appears pale or livid, his hands and feet are cold, and his pulse is generally weak and irregular. He has a great desire for fresh air, and is much oppressed by a close heated room, by dust, smoke, or bad smells, and even by the weight of the clothes upon his chest. After some continuance of the attack headache is superadded to the other symptoms, and, the pulse becoming somewhat accelerated, there is a slight degree of feverishness. As the fit declines there is a discharge of wind both upwards and downwards, and frequently a motion to stool; the expectoration, also, at first, perhaps, difficult, becomes freer, and the urine, which before the fit was pale, is now high coloured, and deposits a sediment,"—a change which seems to imply that asthma is a constitutional rather than a local disease. Such are some of the most prominent symptoms

of a paroxysm of asthma, which is more or less frequently repeated. In the worst cases a painful and most distressing angina pectoris aggravates the sufferings and increases the danger of the patient.

On inspecting the chest of a patient labouring under a severe paroxysm of asthma, the whole upper part seems almost motionless, while the inferior portions are acting within a very confined range. The abdominal muscles, however, act most powerfully. The stethescope teaches us that the whole of the lungs, but particularly the posterior lungs, are labouring with a loud and deep sibilous sonorous wheeze, accompanied with a mucous rattle, sometimes loudest on inspiration and sometimes on expiration. Percussion shows the lung is distended with air; and should an air-cell have burst, a rubbing sound will be heard, denoting the effusion of air into the cellular substance of the lung. As the fit subsides the respiration becomes puerile, and by degrees the breathing returns to its usual state. In fatal cases the respiration becomes tracheal, slight hæmorrhage perhaps takes place, and after a severe struggle the patient falls.

The duration of the fit is very various, for in some cases it lasts a few minutes, in others two or three hours, in others the whole night, in others three or four days, and in others as many weeks.

The frequency of the recurrence of the fit is equally various; sometimes it occurs every night, sometimes every few nights, and at any longer period. The late Dr. Heberden remarked that some asthmatics experience four attacks in the year, others only two, or in spring and autumn, and others again only one attack in the year, and that in winter.

Diagnosis.—The disease with which asthma is most likely to be confounded is a sudden effusion of water into the chest, from which the dulness, on percussion, together with the ægophony, readily distinguish it.

Prognosis.—The prognosis of any given paroxysm is always favourable. Many persons attain old age though suffering many years from asthma. There can be no doubt, however, of its acting unfavourably on the general health, and that it tends to shorten life and predisposes many to apoplexy. When it occurs in early life the patient often gets rid of it.

Treatment.—The treatment comprises what should be done during the fit and what should be done to prevent its recurrence.

The dry asthma is seldom severe, or else sympathetic and connected with disease of the heart. In the first case slight opiates and expectorants are sufficient. In the last, relief must depend on the success which attends the treatment of the primary disease.

When the patient is labouring under a fit of either of the other forms of asthma, our efforts must be directed to tranquillize his sufferings and to shorten the attack; but so capricious is this disease, that what will benefit the patient in one attack will be of little use in another. As a general rule, however, the patient should be supported, and mist. camphoræ, ℥ iss., sp. ætheris nitr., ʒ j., c. confect. opiatæ, ʒ ss., given every hour, or every two hours, for a short time, are among the best remedies. If the head should be affected by the opium, some milder narcotic should be substituted, as tinct. hyoscyami, ♏ xv. or syrupi papaveris, ʒ j., which latter agrees with everybody. In other cases, or in other attacks, assafœtida, castor, musk, or hydrocyanic acid, ♏ iij. 6^tis^ may be substituted. Again, if the fit should occur after a hearty meal, some purgative should be given to empty the stomach, or the tinct. rhei, or the sulphate of magnesia in ʒ j. doses. If the attack be long, arrow root or sago, with small quantities of wine or brandy, should be given to support the patient under this laborious and exhausting attack.

With respect to emetics, the exhaustion they produce is seldom compensated by any long-continued alleviation. Expectorants for a time perhaps relieve the patient, but long continued they impair digestion, create flatulency, and are at length abandoned.

The feelings of the patient should be consulted as to the temperature to which he should be exposed during the paroxysm. In general, where there is organic lesion of the heart and large vessels, the fresh air is extremely grateful and reviving, its coldness giving power to the circulating organs, and by lowering the temperature of the body enables the patient to live on a smaller quantity of oxygen. It is on this principle that the dog asphyxiated by the effluvium of the Grotto del Cane is thrown into the water, he being able to breathe at the temperature of the water when he would have died at the temperature of the atmosphere. The toad, also, when cooled down, will live encased in plaster of Paris, but if his body has a high temperature the experiment is fatal. On the contrary, when the disease is purely pulmonary, warmth, by relaxing the spasm of the bronchial vessels, is generally more useful than cold. It is singular, also, that experiment has shown that animals can live for a short time at a high temperature on a smaller quantity of oxygen than usual, — the rarefaction of the air hardly allowing the arterial blood to undergo any change in the capillary system.

The treatment during the interval must depend very much on the age and pathological state of the patient. In young persons, whose constitution is sound and habits temperate, much benefit will be found from warm tonics and attention to the general health; while in humoral asthma small doses of mercury, or squills, or the tinct. lobelia inflata, are supposed greatly to assist the patient; and in disease of the heart, camphor mixture, sp. ætheris nitrici, and small doses of digitalis are proper. There are a certain class of cases, also, though not accurately determined, which are much benefited by quina.

The inhaling of oxygen, hydrogen, and hydro-carbonated gases has been tried, but with little benefit; and so also of the smoke of stramonium, or other narcotic drug. Blisters are often useful both during the paroxysm and in the interval.

The diet of the patient should be light; he should also wear flannel, and guard himself from cold and wet, especially in his feet. When the disease is prolonged, change of air ought always to be had recourse to.

Emphysema of the Lung.—Emphysema of the lung is the extravasation of air into the cellular tissue of the lung, either in consequence of a secretion, or of the rupture of an air-cell. Dr. Baillie has described this disease, and Laënnec has connected it with its symptoms.

Remote Cause.—The cause of emphysema is often mechanical, and probably arises from the glottis becoming so strongly contracted in a fit of severe coughing, that the muscles of expiration are unable to overcome this obstacle, and consequently some of the air-cells give way, and the air escapes into the cellular tissue of the lung. In other cases it is a primary disease, the air being perhaps secreted into the cellular tissue in the agony of death. The remote causes of emphysema,

therefore, are also those causes which produce cough, and the debility of the last agony of life.

Predisposing Causes.—This disease is occasionally met with in children labouring under hooping-cough, but is most common in middle and advanced age.

Pathology.—In emphysema of the lung, the size of the cells is increased and their form rendered irregular by the extravasation of air. The magnitude of these cells varies greatly, or from a millet-seed to an egg, the larger sized ones being formed by the rupture and communication of one or more cells. The rupture of the cells often detaches the pleura, and permits it to rise above the level of the lung to a considerable extent, so that the affected part has some resemblance to a bunch of currants or of grapes, and that portion of the lung does not collapse, but rather protrudes on opening the chest. In some instances the air escapes through the bronchi on pressure, but more commonly no such effect takes place, showing that the air has been secreted and not extravasated by rupture of an air-cell. Emphysema is found combined with many inflammatory affections of the lungs.

Symptoms.—This disease, it has been stated, occurs only with severe cough, and, strange to say, after its occurrence the cough seems hardly aggravated. It is only determined to be present by auscultation, when it is denoted by a rubbing sound as the lung ascends or descends. Laënnec also adds, a "râle crépitant sec à grosses bulles." These are the symptoms.

Diagnosis.—In pleurisy there is also a rubbing sound. It is distinguished from this disease by the absence of pain.

Prognosis.—Laënnec conceives this disease to be much less grave than might be supposed, for he affirms the air may be absorbed, and the cells heal, leaving a cicatrix. He thinks he has seen many recover, and many certainly do recover after the rubbing sound is present.

Treatment.—When it does yield it is to the general treatment of the cough.

Of Fœtid Breath.

Remote Cause.—A disagreeable taint of the breath often occurs in ill health of whatever nature, but it also sometimes occurs in the best health, and without any assignable cause.

Predisposing Causes.—This affection often attacks children and adult persons of every age and of both sexes.

Pathology.—Andral gives a case of a person who suffered from an extremely offensive breath, and whose body he examined, but without discovering any organic lesion of any kind. This affection is therefore entirely a disease of function. The lungs, indeed, are one of the means by which many substances which mingle with the blood are removed from the body. If a person eat onions, it is not solely because they are in the stomach that the breath smells of them, but because the odorous principle is absorbed and mingles with the blood, and is removed by the lungs. It is the same with alcohol, which is equally given off by the lungs. Again, if phosphorus be injected into the veins, and the animal be placed in the dark, it seems to breathe flames of fire. The lung, therefore, is a secreting organ, and those secretions, like those of other parts of the body, may become diseased and give rise to fœtid breath.

Symptoms.—The symptoms are too marked to need any description. The degree, however, to which the breath may become tainted is quite remarkable, for in some cases it is so putrid as to resemble the odour of gangrene. A man in St. Thomas's Hospital, though otherwise in good health, laboured under this disease to such an extent, that, although he was surrounded with chlorides and aromatics, it was impossible to go near him. A very interesting young lady, who likewise suffered from epilepsy, had so intolerably a fœtid breath that nobody but her own mother could be found to enter her room or to nurse her.

Diagnosis.—It is distinguished from gangrene of the lung by the health not being in any corresponding degree impaired.

Prognosis.—This affection, except in extreme cases, is rarely grave. When the fœtor, however, is intolerable, it is often the forerunner of severe disease, and ends fatally.

Treatment.—In slight cases, gentle purgatives and attention to the general health are sufficient to remove this affection, but for the severe cases that have been mentioned no remedy has been discovered. Surrounding the patients with the chlorides, and with boiling vinegar mixed with aromatics, is some relief to the attendants, but in no degree influences the disease itself.

Of the Neuroses of the Heart.

The neuroses of the heart are angina pectoris and palpitation.

Angina Pectoris is an extremely agonizing pain of the anterior portion of the chest and neck, extending to the shoulder and down the arm.

This disease had attracted little attention, till Dr. Heberden, about seventy years ago, 1772, drew the attention of the profession to it by two papers published in the second and third volumes of the *Transactions of the London College of Physicians.* He connected it with disease of the heart, and it has ever since been treated of in conjunction with the disease of this organ. It has subsequently been studied by Drs. Black, Parry, and Jenner, and by many continental physicians.

Remote Cause.—Every severe functional or structural affection of the heart or lungs lays the foundation of this complaint, and the foundation once established, every atmospheric vicissitude, error in diet, or moral or physical exertion, will bring it on. Mr. Hunter, who suffered greatly from this disease, used to affirm that his life was in the hands of any person or circumstance which acted powerfully on his mind, and, in fact, he ultimately died from strong but suppressed feelings on a point in which he was interested. Ascending a staircase or other acclivity, or indeed any active exertion, is a powerful exciting cause.

Predisposing Causes.—Age has a powerful influence in the production of this disease, for it rarely attacks children unless affected with rheumatism or other disease of the heart. It is not uncommon, however, in early adult age in the paroxysm of hysteria. The aged, however, suffer the most, for out of eighty-four cases noted by Dr. Forbes seventy-two were above fifty and twelve only under fifty. Males have been observed to labour under this affection more frequently than females, or of eighty-eight cases eighty were males.*

Pathology.—Angina pectoris being present in many cases of hysteria and of simple palpitation of the heart, and also of idiopathic asthma, it is plainly often a

* *Encyclopædia of Practical Medicine,* Art. 'Angina Pectoris.

merely functional disease. It exists, however, with most of the organic diseases of the chest, and Dr. Forbes finds in different authors from the time of Heberden the following results, from the examination of forty-five bodies of persons who had suffered from this affection. Of this number there was obesity in four, but no disease; organic disease of the liver existed in two, while organic disease of the heart or larger arteries existed in thirty-nine.

Symptoms.—The attack of this disease is generally sudden, and is characterized by a constrictive anxious pain, fixed most commonly on the left lower half of the sternum, and rarely extending above the fourth rib. Occasionally, however, and especially in rheumatism, it extends over the whole anterior portions of the chest, along the neck to the lower jaw, into the back and shoulder, down the arm to the elbow, and even to the hand and fingers—a course which shows it to affect externally the superficial cervical plexus and its ramifications, as well as the anterior thoracic nerves, the cubital nerve, and its divisions. The pain is also sometimes sub-sternal, and then follows a course which shows that the nervous plexus placed between the folds of the mediastinum, and also the branches of the eighth pair, which go to the large arteries and surround the bronchial tubes, are affected, explaining the cause why the pulse is sometimes rapid, sometimes hardly to be felt; also why the breathing is greatly accelerated, or else imperceptible. Mr. Hunter, when labouring under the paroxysm, could scarcely feel his pulse, and thought he should die unless he exerted his voluntary muscles to carry on respiration, and many have died literally asphyxiated. Darwin has also seen the action of the diaphragm, and consequently the phrenic nerves affected, while Laënnec mentions that the lumbar and sacral nerves also partake of the same disease, which in some measure explains the fact of the urine being sometimes suppressed during the paroxysm. Besides the parts which have been mentioned, the gastric system is also much affected, the patient perhaps being in an instant distended with wind, and only relieved by repeated eructation. In all cases, where the patient is not broken down by disease, the mind is clear, but the face and extremities are cold and pale. At length the paroxysm subsides gradually, when much wind is discharged, accompanied by a copious and almost involuntary flow of pale limpid urine, and the patient recovers.

The time of the attack is extremely uncertain; in asthmatic cases it is often about two o'clock in the morning; while in other cases it occurs at any period of the day or night.

The duration of the fit is very various, for sometimes the pain only lasts a few minutes, while at other times it will continue for two or three hours, a whole day, or even longer. The interval is likewise very uncertain, or from a few hours to a few days, or a few months. Each repetition, however, increases the tendency of the paroxysm to return, and also its violence; and at length, perhaps, an aggravated attack occurs, and puts a period to the patient's existence.

Diagnosis.—The diagnosis of this disease is palpable.

Prognosis.—Angina pectoris, when a primary disease, or the result of hysteria, &c., is rarely fatal. When it is a secondary affection, the danger is in proportion to the nature and degree of the organic lesion on which it depends. If the lesion be of a dangerous character, the angina denotes a paroxysm of unusual severity, and is always a symptom of danger. Dr. Forbes says, of sixty-four recorded cases of angina, forty-nine died, and almost all of them suddenly.

Treatment.—The indication for the treatment of angina pectoris is to support the patient by mild stimuli, as æther, camphor, and by moderate doses of opiates, assisted by a small quantity of wine or brandy and water. If the attack has been preceded by a hearty dinner, some warm purgative, as the decoct. aloës comp., or perhaps an emetic should be exhibited. The paroxysm past, we must look to amend the general health of the patient. The organic affections, however, are generally of an irremediable nature.

During the paroxysm the patient will find a recumbent posture, fresh air, and perfect quiet, greatly contribute to restore him. Dr. Forbes gives a case in which the party was seized on horseback, when, continuing his course, he fell dead off his horse.

Of Irregularities of the Heart's Action.

The heart may beat abnormally slow, may intermit, may have a rolling action, or its pulsations may be so frequent, and its action so irregular, as to be termed *palpitation.* These states are all caused by an irregular innervation of the heart, by which it is rendered morbidly sensible or insensible to its natural stimulus, the blood. The excessively slow pulse is often caused by some pressure made high up in the cervical portion of the spinal cord, or else by congestion or pressure on the brain. The other states are perhaps inexplicable, and may be considered as ultimate facts. The irregular and rolling action of the heart is, in general, accompanied with hypertrophy, or other disease of that organ, and will be best treated of under those heads of disease. Fits of palpitation, however, may occur in the most healthy subjects, and in the most healthy hearts, and this neurosis of the heart is the only one of which we shall now treat.

Palpitatio is an abnormal innervation of the heart, by which its actions are rendered often highly irregular, and its pulsations remarkably increased in frequency.

Remote Cause.—The excitability of the hearts of young people is readily accumulated and as readily exhausted. Everybody is aware how powerfully every passion and every affection acts on the heart and changes its healthy beat; as also how every error in diet, or any over-exertion, may produce the same effect. Every moral, as well as almost every physical cause, may consequently be the remote agent in the production of palpitation, while every pathological state of the heart may be accompanied by it.

Predisposing Causes.—This affection of the heart, as a primary disease, seldom occurs before puberty, but after that period it is common, and often to a most distressing degree in both sexes. The female, however, suffers more than the male, and especially during amenorrhœa, or at the period of menstruation, and in more advanced life when menstruation ceases.

Pathology.—That palpitation is merely a disease of the function of the heart, is evident from the number of young persons who suffer from it, and who afterwards attain a hale old age. Laënnec says it is generally believed that habitual palpitation of the heart at length terminates in hypertrophy or dilatation of that organ; but he adds, "I have seen nothing to establish this fact." Palpitation, however, is a symptom of every disease of the heart, and consequently every diseased

state of the heart is found concomitant with this affection.

Symptoms.—The attack of palpitation may be sudden, or it may be preceded by acidity, flatulence, or other affection of the stomach. It has many degrees. In young persons of a delicate constitution it often occurs in a slight degree nightly; so that the patient, on going to bed, passes many hours sleeplessly, not only feeling his heart beat but also hearing it. His subsequent sleep is unrefreshing, and he awakes in the morning more tired and jaded than when he went to bed.

In some cases, as in young women labouring under leucorrhœa, the palpitation is constant, the pulse beating for many weeks at 150 to 180 strokes in a minute. In other cases it is paroxysmal. When the paroxysm is formed, the pulse may still preserve a regular rythm, only greatly increased in frequency, while its force may be increased or diminished. In the severest cases, however, the pulse is so rapid that it has a mere vibratory motion, and cannot be counted, while its rythm is extremely irregular. The force of the heart's action also is now excessive, and now not to be felt. In general the contraction of the ventricles is so rapid that it is impossible to hear the sound of the auricles; and again, so singularly irregular is the action of the heart, that the auricles may contract at the same time as the ventricles, or perhaps contract three or four times for the ventricles' once; and indeed the heart appears to act with every possible degree of irregularity. In general the other branches of the eighth pair are affected besides the cardiac branch, for the patient often becomes distressingly distended with flatus, and that almost on the instant, while his deep sighing shows the pulmonary as well as the gastric branch to be involved. The patient having lain in this state, pale, anxious, and restless for a greater or less length of time, the fit at length terminates, and the pulse perhaps is restored to its natural frequency and healthy rythm as instantaneously as it had lost them. The patient now passes a considerable quantity of pale limpid urine, and, though feeble from exhaustion, is once more able to sit up and so far to exert himself.

The duration of the paroxysm is very various; sometimes it lasts a few minutes, sometimes a few hours, while Laënnec speaks of a paroxysm connected with organic disease which lasted a week. The interval between the paroxysm is also uncertain. In young persons it may occur every twenty-four hours two or three times a week, or every month; or a still longer period may elapse.

Diagnosis.—The fact of palpitation cannot be mistaken.

Prognosis.—Palpitation is seldom dangerous, unless conjoined with organic disease of the heart, and when merely an idiopathic disease, it frequently subsides as the patient advances in life.

Treatment.—During the paroxysm the patient should lie flat on his back, bare his neck and chest, and allow the air to blow freely over him. The best remedies are camphor mixture and æther ʒi., with some slight opiate, as the syrup of poppies ʒj., or else tinct. hyoscyami ♏xx.; and this should be repeated every quarter, or every half hour, or hour, according to the severity of the attack, till the heart's action is stopped. Cold brandy and water, as it is always at hand, is an excellent substitute for, or adjuvant to, that medicine. Again, if the attack occurs shortly after a meal, some purgative medicine should be given to clear the stomach.

The paroxysm past, the patient, though much exhausted, speedily recovers his usual health, which is generally feeble. It is useful, however, to continue the medicines which have been mentioned, but at longer intervals, for some time. It is important in these cases, however, to counsel the patient strictly as to diet, for without such auxiliary assistance medicine is often of little service. On questioning these patients, we constantly find that the palpitation returns after tea or after breakfast, or whenever hot tea or hot coffee has been drank, and in these cases it is extremely desirable to wean the patient from all hot slops, and to induce him to drink cold water at his breakfast and indeed at every meal; his wine also should be limited to two or three glasses of sound sherry, and should be drank diluted with water. There are few tonics so beneficial as the natural tonic of cold water, and persons once accustomed to it feel a return to a modern breakfast as a punishment rather than a gratification.

Of the Neurosis of the Urinary Organs.

The kidneys are the organs by which ten-elevenths of all the azote introduced into the system, as aliment, is discharged. They are also the means by which a large portion of the fluids, all the phosphates, as well as many extraneous substances received into the circulating system, as turpentine, copaiba, myrrh, iodine, rhubarb, the odoriferous particles of asparagus or of buchu, are removed from the body. In health, the specific gravity of the urine varies from 1015 to 1025, and the following substances, according to Berzelius, are found in it:—

Water	933·00
Urea	30·10
Uric acid	1·00
Mucus	·32
Lactic acid, free lactate of ammonia, animal matters soluble in alcohol	17·14
Sulphate of potash	3·71
Sulphate of soda	3·16
Phosphate of soda	2·94
Phosphate of ammonia	1·65
Muriate of soda	4·45
Muriate of ammonia	1·50
Earthy matters	1·00
Silex	0·03
	1000

Such is a general view of the composition of human urine in its healthy state. But this fluid is subject to a great variety of morbid conditions. Its quantity may be greatly diminished or increased, or it may be suppressed altogether. The usual salts, as the urea, the urates, and the phosphates, may be in great excess, and hence lay the foundation of those distressing complaints, stone and gravel; or they may be in great defect, as in most nervous disorders. Besides these alterations in the proportions of its healthy constituents, urine may contain many morbid secretions, and, strange to say, this acrid fluid is sometimes sweet, containing a considerable portion of sugar, causing the disease termed diabetes mellitus. The other morbid secretions of the urine are oxalic acid, giving rise to the mulberry or oxalate of lime calculus, and those substances termed cystic oxyde and xanthic oxyde. Albumen also very commonly

Elementary Principles of Medicine.

exists in large quantities in the urine; but this latter disease, when of any extent, is so constantly accompanied by disease of the kidney and by dropsy that we shall treat of this particular affection under the head of dropsy.

The average quantity of urine discharged daily in health is estimated to be about thirty-five ounces. When this quantity is greatly in defect the disease is termed anuria; when in great excess it is termed diabetes insipidus.

Anuria; ischuria renalis is a complete or partial suspension of the functions of the kidney, by which the quantity of urine is greatly in defect, or its secretion entirely suppressed. One hundred and sixteen cases are said to have died of this affection in England and Wales in 1839.

Remote Causes.—This affection may be caused by disease of the kidney itself, or it may be secondary, and arise from disease in other parts of the body. Among the latter are injuries of the head or spine, an affection of the brain in fever, an attack of pneumonia, when the patient will sometimes hardly pass a few ounces of urine in twenty-four hours, or of hysteria, when it is often suppressed for several days together, and also of inflammation or high irritation of the bladder. When the disease is idiopathic it may depend on inflammation of the kidney, caused perhaps by some poison acting on that organ, as that of small-pox, or else by cantharides, or turpentine. Anuria is also caused by those many undefined conditions of the kidney which produce dropsy. The presence of a calculus also in the kidney or the ureter is also an occasional remote cause.

Predisposing Causes.—All ages are liable to this affection; children from teething often suffer a complete suppression, or only pass a few drops of fiery urine in the twenty-four hours; the adult from gravel or stone; and the aged from disease of the brain or cord. Both sexes equally suffer from it, and especially when labouring under dropsy.

Symptoms.—The existence of complete anuria is palpable, the patient passing no urine; and, again, if the catheter be introduced, no urine flows through it. When the suppression of urine is merely symptomatic the symptoms are little marked, being lost in the greater disease. The patient, however, may complain of some pain in the back, of some irritability of the bladder; he then becomes anxious and restless, till at last the brain is oppressed, and he dies comatose. In other cases there is nausea, hiccough, and the body exhales an urinous odour. When the suppression is less complete, and depends on an affection of the bladder, the local sufferings of the patient, the forcing of the bladder, the tenesmus, and the general irritation of the poor sufferer are most severe and distressing.

The time during which the urine may be suppressed, and yet the patient recover, is very various. Children when teething often void only a few drops of urine, and that at several hours' interval. The urine passed at such times is extremely high-coloured, stains the linen, and is passed with great pain, the child crying bitterly as it scalds the surface over which it flows. In hysteria the urine is often suppressed for three or four days. Dr. Laing, of Fochabers (*Edin. Med. and Surg. Jour.*, vol. x.), gives a case in which no urine was secreted for nine or ten days, and yet the patient did well. As extreme cases, Dr. Parr, in his *Medical Dictionary*, mentions a patient who made no water for twenty-two weeks, while Dr. Richardson speaks of another who up to seventeen years of age had never passed a drop of water in his life. In this case the ureters must, as in birds, have terminated in the large intestine, and the urine have been passed with the fæces. In general, however, it may be laid down as a maxim, that when suppression of urine depends on any acute or severe disease the patient seldom survives this symptom more than three or four days.

Elementary Principles of Medicine.

Among the symptoms mentioned by authors of the suppression of urine is an urinous odour of the perspiration from the axilla and umbilicus, and they have accounted for it by supposing the urine to be first secreted and then absorbed. Much doubt hangs over these cases, for the suppression perhaps is not complete —a few drops wet the bed, the hand becomes impregnated, and an urinous smell is thus imparted to distant parts of the body. It is certain also that some of these cases are feigned; some women, for instance, are said to have had a vicarious discharge of urine from the stomach, and Nysten gives the case of a girl who vomited urine, but it was at length ascertained she first swallowed it. Another girl vomited not only urine but well-formed fæces, but it was also discovered that she first swallowed them. Rayer gives a similar case of a woman at La Charité, who had an abdominal tumor, which was supposed to be connected with the kidneys. Many persons saw her vomit urine, and Guibourt detected it chemically in the matters thrown up, but, strange to say, she had first drank it, though for what motive, except notoriety, nobody could imagine.

Diagnosis.—This disease is to be distinguished from mere retention of urine in the bladder, or from ischuria vesicalis, by there being no fulness in the vesical region, and by no urine flowing when the catheter is passed.

Prognosis.—Many cases recover from a suppression of urine of not more than twenty-four to forty-eight hours, but, except in hysteria, few survive if the disease continues a longer period.

Treatment.—When anuria is idiopathic and primary the patient should be placed in a warm bath, and be purged by substances that act on the kidney, as the neutral salts. Indeed, if the case be slight, purging by any cathartic is sufficient. If this method should not succeed, ♏ x. to xxx. of the tinct. cantharides should be tried every four or six hours, according to the urgency of the case. Many physicians, however, prefer a tonic treatment, as the camphor mixture and æther, the haustus olei cum manna, or the tinct. ferri muriatis, ♏ xxv. to ♏ l.

The treatment of symptomatic anuria resolves itself entirely into that treatment which will remove the primary disease.

Diabetes Insipidus

Is a considerable excess of the urine, so that instead of thirty-five ounces it amounts to several pints in the course of the twenty-four hours. There are two forms of this disease, or Hydruria and Azoturia.

Hydruria is a copious discharge of limpid watery urine, containing the usual ingredients, but small in proportion to the quantity of urine passed, so that its specific gravity varies from spring water, or 1001 or 1002 to 1008 to 1010.

Remote Causes.—The causes of this affection are probably the usual general causes acting upon a highly nervous temperament, it having been observed princi-

pally in hypochondriacal persons of feeble constitution, and whose diet has been low, or who have been much exposed to the accidents of life.

Predisposing Causes.—Hydruria has been met with by Dr. Watson, in a boy aged thirteen, who passed nineteen pints of urine daily of the sp. gr. of 1002. It is more common, however, from twenty to forty, and again in old age, and particularly in old men.

Pathology.—In such cases as have fallen at the early periods of life, the kidneys have been found healthy. In old people it appears associated with organic disease either of the kidneys or neck of the bladder.

Symptoms.—The leading symptom, or an excess of pale urine, is palpable, and cannot be mistaken, and on examination the fluid passed is found to be either neutral or to have only a faint acid re-action. A patient aged twenty-six fell under the care of M. Peschier, who passed ten to twelve pints of urine daily, of a light citron colour, of an urinous odour, and which still reddened vegetable blues. On analysis, the quantity of urea was trifling, ninety ounces of this urine yielding only 1095 grains of solid extract, instead of 3000 grains. Dr. Storch gives a case in which eight to twelve pounds of urine were passed daily, and in which there was hardly a trace of urea or of any of the usual salts. Dr. Willis also gives the case of a boy three and a half years old, who drank about four pints in the twenty-four hours, and whose urine was as near as possible of the specific gravity of distilled water, and 100 grains evaporated left but the fraction of a grain of solid residue. The specific gravity of the urine, which in health may be taken at 1010 to 1020, sinks in this disease to 1002.

The general health of these patients is always feeble. In person they are emaciated, pale, and often complain of pain in the back.

Treatment.—The treatment of this disease is by mild opiates, tonics, and attention to the general health.

Azoturia, Diabetes Insipidus.—In this form of disease the quantity of urea which exists in healthy urine in the proportion of 30 parts to 1000, and amounting to about an ounce and a half in the twenty-four hours, is often increased five-fold, to 150 parts in 1000, or to seven ounces and a half in the twenty-four hours, while the specific gravity is raised from 1010 to 1015 in health to 1020 and even to 1030. This is a rare form of disease, and according to Dr. Prout there are twenty cases of diabetes mellitus to one case of diabetes insipidus.

The *remote* and the *predisposing causes*, and likewise the pathology, as far as the facts of the disease are at present known, are exactly the same as in hydruria. The circumstance of the kidney being found healthy in this affection is explicable on the ground that the experiments of Prevost and Dumas have rendered it probable that urea exists formed in the blood, and that the office of the kidney is to separate it from that fluid. It will be seen, however, that urea being composed of oxygen, hydrogen, carbon, and azote, elements found abundantly in the blood, that it may be a secretion, and its excess a mere functional derangement of the kidney.

Symptoms.—There are supposed to be two forms of this disease, or diabetes insipidus with diuresis and without diuresis. In the latter case the urine is of the colour of porter, small in quantity and of great specific gravity. In the former the urine is pale, greatly increased in quantity, amounting often to eight, ten, sixteen, or more pints in the twenty-four hours, has an urinous odour and an acid re-action. The mode of determining the excess of urea is by pouring a small quantity of urine into a watch-glass and treating it with nitric acid. If the salt be in great excess, crystals of nitrate of urea will be seen at the edge of the fluid in a few hours. If, however, the quantity be smaller, it may be necessary to evaporate to about one-half before crystals will form. The crystals of the nitrate of urea are four-sided prisms, are neither acid nor alkaline, and are readily soluble in their own weight of cold water, and in any quantity of boiling water. Cold alcohol dissolves twenty per cent., and boiling alcohol any quantity of this substance.

The patient suffering from that form of the disease which is accompanied by great diuresis, is usually emaciated, hollow-eyed, sallow, and worn down by the great loss of azote. His bladder is also highly irritable, from the large quantity and morbid state of the urine with which it is so constantly distended; his bowels are likewise constipated, while his skin is harsh and dry, and without perspiration. On the contrary, when the diuresis is inconsiderable, he often preserves a considerable degree of *embonpoint*.

The duration of azoturia, if left to itself, is always long and tedious, pursuing an uninterrupted course of many months or years, and often when it subsides there is a metastasis to the lungs, and the patient dies of phthisis.

Diagnosis.—This disease can only be confounded with diabetes mellitus, and is readily distinguished if the party has the courage to taste, or the ingenuity to evaporate a small portion of his urine.

Prognosis.—The prognosis is always favourable, unless there be metastasis to the lungs, and then the patient usually falls.

Treatment.—No one definite plan of treatment can be laid down for this disease, but the milder forms are benefited by mild opiates, and the severer forms by opium and the mineral acids, as the infusi rosæ c. acidi sulphurici diluti ♏ v. c. tinct. opii ♏ iij. to ♏ x. 6^tis vel 4^tis horis; preparations of iron are also useful. Dr. Prout conceives calomel, black dose, and saline purgatives are calculated to do infinite mischief.

In hydruria, the diet should be generous and the quantity of animal food increased. On the contrary, in azoturia the quantity of animal food should be diminished.

Diabetes Mellitus.

The peculiarity of this disease is that the urine is sweet, and actually contains sugar. Its quantity, also, is for the most part greatly increased, amounting to many quarts, while its specific gravity ranges from 1020° to 1050°, and even higher.

The saccharine quality of diabetic urine was first discovered by Willis, the contemporary of Sydenham, and the subject has since been chemically investigated by Cruikshanks, Rollo, Prout, Bostock, and many still more recent writers. Two hundred and fourteen cases of this disease are reported to have died in 1839 in England and Wales.

Remote Causes.—The remote causes of this disease are extremely obscure; it has been attributed to wet, to cold, and to excess in sexual pleasures, to malaria, to mercury; these, however, are insufficient, unless a strong idiopathic disposition exists.

Elementary Principles of Medicine.

Predisposing Causes.—Diabetes mellitus has rarely been seen in persons under twenty. Both sexes are liable to it, but men are more commonly affected than women; thus of those that fell from this disease in 1839, 151 were men, 63 women. The parties whom diabetes mellitus attacks are generally thin and emaciated, but occasionally full and plethoric. Dr. Prout mentions one gentleman that weighed twenty-three stone, and another who weighed seventeen stone. It has been observed in some instances to be hereditary, and in others to run in families. One German writer says he has seen seven cases in one family.

Pathology.—The kidneys in diabetes mellitus are often found healthy, but more commonly perhaps they are large, congested, and their vessels easily injected. In some few instances the kidneys have been found smaller or harder than usual, or to have undergone granular degeneration, or to have been beset with hydatids; but these forms of structural disorganization often exist without any tendency to diabetes, so that such conditions are altogether accidental. All pathologists therefore are agreed that diabetes mellitus is a disease of function.

Much speculation has been entertained whether the sugar contained in diabetic urine is formed by the kidneys, or is merely separated by them from the blood. Dr. Prout advocates the first opinion, and thinks the albumen of the blood is the radical from which not only urea and lithate of ammonia, but also sugar, are capable of being formed, and the following table will perhaps best show the foundation of this hypothesis :—

Elements.	Albumen.	Urea.	Lithic Acid.	Sugar.
Hydrogen	8·75	2·5	1·25	1·25
Oxygen .	30·00	10·0	15·00	10·00
Carbon .	56·25	7·5	22·50	7·50
Nitrogen .	17·05	17·5	17·50	0·00
	112·05	37·5	56·25	18·75

Whether the hypothesis of Dr. Prout be the true one is perhaps uncertain; but the formation of sugar by the kidney is rendered something more intelligible by the fact of the quantities of hydrogen and of oxygen in sugar being the same as those in water, and we have only, therefore, to account for the addition of the carbon, which exists abundantly in the blood, and the elements of sugar are palpable.

The hypothesis of sugar existing in the blood, and only separated by the kidney, has long been entertained; but even the delicate manipulations of Wollaston failed to detect it. Ambrosiani, of Milan, and Dr. Charles Maitland, however, are said to have obtained crystals of pure sugar from the blood, and also a larger portion of fermentable uncrystallizable syrup. More recently, Mr. Macgrigor, by coagulating and drying the albumen, then boiling it in water, and afterwards concentrating the decoction, obtained a syrupy fluid, which fermented for several hours with yeast; while Dr. Christison has even obtained sugar, but only in the proportion of one grain to eight ounces of blood.

The source of the sugar, according to Mr. Macgrigor, is the stomach, which generates it during digestion, when, in consequence of an imperfect chymification, it is afterwards taken up by the lacteals. In proof of this supposition, he states that he has repeatedly found sugar in the matters vomited after digestion had begun, and even in a case where nothing but animal food had been taken for a long time, and also that he has abundantly detected it in the fæces.

Symptoms.—The early symptoms of diabetes mellitus are obscure. Dr. Prout conceives there is a stage which precedes the formation of sugar, and which is marked by a superabundant and highly dense urine, loaded with an excess of urea. But much uncertainty prevails on this point, and nothing is assured except that the constitution is not greatly affected till the saccharine matter forms. In some very few instances the quantity of urine passed is hardly greater than in health, but more commonly it is in great excess, amounting to eight, ten, sixteen, thirty, and even more pints, so that the patient is incessantly disturbed in the night, and loses his sleep, while the urethra and prepuce are inflamed and sore.

At this period his health begins to give way, his thirst is intense, and he often drinks many quarts, or even gallons, in the course of the day. But as the quantity drank is generally less than the quantity of urine passed, being in some instances only as one to four, his bowels are costive, and his fæces hard and dry; his appetite is capricious, his skin harsh and moistless, and he becomes greatly emaciated, loses all sexual desire, and it is said all sexual power. In advanced cases, the drain upon his constitution is so great that the alveolar processes are absorbed, and his teeth, loosened in their sockets, fall out. These symptoms are much relieved by medicine, and life much prolonged; but often, when the case appears most favourable, a latent phthisis, or other affection of the lung, breaks out, and he sinks under this unconquerable and intractable disease.

When the diuresis is considerable the urine should be examined, and its constituents determined; and the readiest solution of the problem is to taste it, and if it be sweet there can be no doubt of the nature of the disease. The chamber-vessel should also be examined, as also the flap of the patient's breeches, for crystals of sugar often form in the one as well as on the other. If we proceed chemically, a portion of urine, which is usually of a light straw colour, should be taken, and its specific gravity determined; and if greater than 1020° it should be evaporated, and if sugar be present we shall have a dark-brown residue, something like treacle. This extract, like the natural sugars, consists of crystallizable matter and of an uncrystallizable syrup; and to separate them Dr. Christison recommends that the extract be agitated with rectified spirit, and the residue boiled in another portion of the same fluid, when, on cooling, the crystallizable sugar will separate in light greyish grains like grape-sugar. Again, if sugar should be suspected to exist, but only in minute quantity, a small portion of yeast should be added to a small quantity of the urine, when, if sugar be present, fermentation will ensue, and each square inch of carbonic acid given off corresponds nearly to one grain of sugar. This test is so delicate that one part of diabetic urine, according to Dr. Christison, may be detected in 1000 parts of urine of the density of 1030.

Another method of determining the presence of sugar in the urine arises out of an experiment by Dr. Wollaston, who showed that when fluids of different densities are superposed one on the other, we have the phe-

nomenon of double refraction. If a portion of diabetic urine, therefore, be left to stand for a few hours, the sugar will gravitate towards the bottom of the glass; and in this manner two fluids of different densities are formed, and the phenomenon of double refraction rendered apparent.

The density of diabetic urine, however, is one of the best tests. This fluid varies in density from 1020° to 1055°; and when the urinometer stands above 1030°, we may confidently affirm that sugar is present. The quantity of sugar present has been calculated by Dr. Henry at 1020° to be ʒ vj. ℈ ij. gr. ij. in every pint, while at 1050° it contains ℥ j. ʒ vij. ℈ ij. grs. xviij. of sugar—the increment being, as he conceives, one scruple, or nearly so, for every degree of specific gravity between the extremes that have been mentioned. If these data be correct, a person passing 16 pints of urine daily, of specific gravity 1050°, actually passes nearly 2 lbs. avoirdupois of sugar.

As sugar is a non-azoted substance, it has been supposed that diabetes mellitus indicated a non-azoted diathesis of the kidney; and, consequently, that urea was always deficient in this disorder in proportion to the quantity of sugar secreted. It has been shown, however, by Henry, that although urea could not be detected by the ordinary methods of analysis, still that diabetic urine gave off carbonate of ammonia at a boiling temperature—a substance, he conceived, that could be derived from no other source than urea. At length Mr. Macgrigor, by first destroying the sugar by fermentation, and then concentrating the urine and treating it by alcohol, obtained in one case 43 parts of urea in 1000 of diabetic urine, or nearly 50 per cent. more than healthy urine contains; and Dr. Christison has obtained it in several instances by a similar process of fermentation, and then treating the urine with nitric acid.

The duration of this disease is very various; it always lasts many months, generally two or three years, and sometimes the patient has reached a moderately advanced age.

Diagnosis.—The sweet taste of the urine, the crystallization on the clothes of the patient, and the peculiar treacle-like syrup which remains after evaporating the urine, distinguishes this disease from all others.

Prognosis—The ultimate issue of every case of diabetes is probably fatal; at least the number of cases in which the urine is rendered natural is extremely small, and many of them, at the moment the disease seems to have yielded, die of phthisis; even when the presence of the saccharine principle has been so far conquered that it alternates with lithic acid deposit, or that lithic acid becomes the prominent feature, the circumstance is anything but favourable, for I have noticed, says Dr. Prout, that such individuals generally die of some sudden and overwhelming attack of internal inflammation or of apoplexy.

Treatment.—There are few diseases in which the treatment has been more varied than in diabetes mellitus. The emaciated state of the patient would seem to present an insurmountable obstacle to bleeding; but, nevertheless, this mode of treatment has often been practised, and as much as 160 to 170 ounces of blood have been taken in a few weeks. Mercury has been used as an adjunct to bleeding, and separately; first as an alterative, then to touch the gums, and lastly to produce profuse salivation. But neither bleeding nor mercury, separately or conjointly, have been found of any benefit. Opium has been given to the extent of 100 grains in the 24 hours; but with an equal want of success. The whole materia medica has been exhausted in search of a remedy for this disease; and the metals, the fixed and volatile alkalies, the vegetable and mineral acids, all the astringents, purgatives, emetics, diaphoretics, diuretics, and tonics have in their turns been exhibited, and each has, perhaps, afforded some relief; but the disease has proceeded, and finally it may be said nearly every patient has fallen. Dr. Prout, who considers it merely as a form of dyspepsia, conceives that each case may require a different treatment.

The little benefit derived from medicine induced Dr. Rollo to try the effects of an entirely azoted or animal diet; and out of nineteen cases two are said to have been cured by this means. A full and generous diet is unquestionably useful in these cases; but the patient soon gets disgusted with mutton or beef, or both, for breakfast, dinner, and supper; he consequently nauseates it, and abandons it altogether. A diet of salt fish was attempted in one instance; but the patient in a short time so loathed it that it was given up. A mixed diet, therefore, if contra-indicated by theory, is at least the best to adopt in practice. It will be evident, however, that those vegetables which contain a large quantity of saccharine matter should be avoided in some degree, as potatoes, grapes, or other very ripe fruit, and, *à fortiori*, sugar itself.

Of Urinary Deposits.

In the diseases of the functions of the kidney that have been mentioned, the urea, sugar, or other product has been held in solution. Two of the natural constituents of urine, however, as the phosphates and the lithates, although held in solution in that fluid in the proportions of health, yet being in excess become deposited, forming urinary sediments, and which, being precipitated in an amorphous state, are termed *sand;* in a crystallized state, *gravel;* and when concreted into masses, *stone* or *calculus.* Besides this excess of the natural constituents of the urine, there are also some other precipitable substances occasionally found in the urine, which are entirely new or morbid formations, as the oxalate of lime, and the xanthic and cystic oxydes, substances, although soluble, perhaps, in certain proportions in healthy urine, yet being in excess become deposited, and form urinary sediments, which for the most part concrete into calculi. The diseases produced by these different substances are termed Lithuria, Ceramuria, Oxaluria, Cystinuria, and Xanthuria. Our knowledge of urinary deposits, of whatever kind, is principally due to Scheele, Marcet, Wollaston, Yelloly, and Prout. The frequency of calcareous formations is not great, for 299 cases only are reported to have died of these diseases or of stone in England and Wales, in 1839.

Lithuria, or *Lithic*, or *Uric Acid Diathesis*, is that form of disease in which the lithates are secreted in such excess as to be deposited in inordinate quantities in the chamber-vessel on the urine cooling; or when in still greater abundance, deposited in an amorphous or crystallized state, either in the cavities of the kidneys or bladder. The specific gravity of this urine varies from 1015 to 1035, and always gives an acid re-action, and is of a deep copper or red colour.

Remote Cause.—Persons labouring under idiopathic uric acid diathesis are in other respects generally healthy,

and the remote cause is for the most part referred to errors in diet, to sedentary or indolent habits, and, as this class of persons are for the most part nervous, to every atmospheric change. If we analyze the first of this series of causes we find that a too full animal diet, as rich old black meats and game, are among the most frequent. When the predisposition, however, to this diathesis is great, every substance, even the most opposite, that causes indigestion will produce it, as a heavy dumpling or new bread, the richer sort of fish or salted meats, acid fruits, or saccharine matters. Among wines, port is found too heavy, and claret and the lighter French wines too acid; while champagne, cider, and malt liquors are still worse, from the rapidity with which they ferment and turn acid.

Besides being the result of many errors in diet, a deposit of the lithates is incident to many diseases, as gout and rheumatism. It is also often a critical termination and first faint indication of recovery from fever, or severe form of inflammation. It is also imagined to result from morbid states of the liver. Besides denoting remote diseases, it sometimes results from an irritable state of the bladder, or from stone in the kidney or bladder.

Predisposing Causes.—The effects of diet are so marked in children, that we can hardly feel surprised that any error of diet, as overfeeding them, should be followed by lithic acid deposits. Stone cases are consequently common in children, and occur chiefly among those of the lower class, in whom those errors are likely to be most considerable. It is supposed that when stone forms in childhood that the ages most affected are between four and nine years. But of 506 children operated on at the Norwich Hospital, 223 were under 12 years of age, while 271 were between 14 and 15. Now two-thirds of all the cases of stone result from an uric acid diathesis. After these periods the ages of 40 and upwards present the greater number of cases of gravel, either because the frame now begins to break, or that increasing age enables us to enjoy the pleasures of the table, as well as to lead a more sedentary life. Majendie has assigned as a cause of these morbid states of urine in the extreme of life that the temperature of the body is from one to two degrees below the healthy standard of the adult.

Both sexes are liable to this affection; but taking stone cases as a test, men are infinitely more liable to uric acid deposits than women, for, according to Dr. Marcet, of 2216 cases operated on, only 88 were females. In many instances this disease appears to be hereditary, and the parties attacked are usually of sthenic constitution.

Pathology.—Lithic acid deposits not only occur when the patient is in his best health; but in many persons who have fallen labouring under this diathesis the kidney has been found healthy. Lithuria consequently arises from a mere derangement of the functions of the kidney. Indeed so purely is it a disease of function that the healthy kidney has been found occasionally studded all over with crystals of uric acid. Uric acid diathesis, however, may co-exist with most forms of disease of the kidneys, ureters, or bladder. It is by no means uncommon to find a calculus of this substance the nucleus of a mulberry or other calculus formed in the tubuli or pelvis of the kidney, and sometimes in the bladder.

Much difference of opinion prevails respecting the chemical nature and solubility of what is usually termed lithic acid. The analysis of Dr. Prout, however, on this subject is most generally received in this country. This eminent physician states that lithic acid may be precipitated in a crystalline form from urine that contains it by the addition of any mineral acid. The crystal is of a rhomboidal or cubic form, the latter being much the most rare, and is readily detected, on evaporation, by the microscope; it is white, tasteless, and inodorous, insoluble in alcohol, and very sparingly soluble in water, or requiring 10,000 times its weight of that fluid at 60° for solution. It reddens litmus paper; unites with alkalies, forming salts; and undergoes no change by exposure to air. On analysis it gives,

Carbon .	.	36	or 6	equivalents.
Hydrogen	.	2	or 2	ditto.
Oxygen.	.	24	or 3	ditto.
Nitrogen	.	28	or 3	ditto.
		90		

These crystals, when treated with nitric acid, still form colourless crystals of a similar shape, and have an acid re-action, but what is remarkable is, that they form pink, red, or purple-coloured salts with an alkaline base, or different proportions of an alkali, and are hence termed by chemists purpuric acid, erythric and rosacic acids.

The different acids which have been described readily combine then with ammonia, with soda, or potash, and form with them super-lithates, lithates, and sub-lithates. The super-lithate of ammonia or the super-purpurate of ammonia are those, however, which are most generally found in urine. They give an acid re-action, and one part is soluble in 480 parts of water at 60°. In healthy urine they usually exist in the proportion of one part in 1000, which, taking the temperature of the body at 98, gives a three-fold excess of the solvent.

The colour of these salts varies greatly. The pure sub-lithate of ammonia is white; but, owing to the presence of the colouring matter in the urine, it is usually deposited of a yellow or wood colour. The purpurates, owing either to the nature of the colouring matter of the urine, or else to other circumstances not yet determined, are deposited of a pink, light red, or brick colour. These different salts may be deposited in a crystallized or in an amorphous state. The yellow amorphous sediments form calculi; but it is remarkable the red amorphous sediments in no instance are known to concrete into a calculus.

The lithic acid which exists in healthy urine in such a state and in such proportions as to be held in solution at ordinary temperatures, in certain conditions of the system may be precipitated from that secretion in a *crystallized* and nearly pure state, a specimen of which is now before us. In other states, or, according to Dr. Prout, when no febrile action exists in the system, the crystallized lithates are usually stained with the deeper tints of the yellow colouring matter of the urine, and are sometimes of a dark brown or red, so as to appear at first sight almost black. When, however, the patient labours under febrile action they are generally more or less of a red or lateritious colour; but in no instance has the same great authority seen crystallized lithates of a pink colour.

The *amorphous* and impalpable lithic acid sediments consist in general of lithic acid in combination with ammonia, and only in a very few instances with soda. The sedimentary deposits of the lithates of ammonia may be yellow, pink, or red; while the sedimentary

deposits of the lithates of soda are white. The crystallized salts form gravel. The yellow amorphous sediments may concrete in the bladder or kidney, and form calculi.

In general the lithates and purpurates, whether in a crystalline form or as an amorphous sediment, even when in great excess, are held in solution at the temperature of the body; but in some instances their superabundance is so great that they are deposited, even at this temperature, either within the bladder or kidney, so that the last portions of urine are so loaded with them as to resemble a stream of blood. If the excess be yet greater, or if a nucleus be present, a concretion may form either in the kidney or bladder, but infinitely more commonly in the former. The nucleus may be either a piece of hardened mucus, or a portion of fibrine or other substance, or it may be a crystal of lithic acid. The formation of crystals of lithic acid has been variously accounted for. Dr. Prout thinks they may be deposited in the kidney as a gelatinous hydrate; or that they may be precipitated by the presence of nitric acid depriving the acid of its base; or that a portion of thickened mucus may afford a nucleus on which they may shoot and crystallize. In whatever manner, however, the nucleus may be formed, or of whatever substance, around this nucleus the amorphous sediments are gradually deposited. The calculi thus formed are of very different sizes, sometimes so minute as to be not bigger than a pin's head; but if longer retained they acquire a magnitude from a walnut to a goose's egg.

Calculi of pure lithate of ammonia are so rare that their existence has been denied; but they have been met with in infants and children. Lithic acid calculi are, therefore, generally lithate of ammonia mixed with many impurities, and are hard, of a light clay, fawn, or wood colour, for the most part smooth at the surface; and the concretion, when sawn in two, is found to be composed of concentric layers, like an onion. The simplest test of this form of calculus is nitric acid, which readily dissolves it, and on evaporation yields purpurate of ammonia.

The lithates, however, are very frequently only the nucleus of a calculus of different formation, as the phosphates or oxalates. Indeed we not unfrequently see the lithates, the phosphates, and the oxalates deposited in alternate layers in the same calculus, thus affording absolute demonstration of three or four different diatheses having prevailed during the formation of the same calculus.

Symptoms.—The fact of lithic acid being in excess is palpable enough, from the yellow, red, or pink deposit in the chamber-vessel as the urine cools; and when this is moderate in quantity the patient, perhaps, suffers neither local nor general inconvenience; indeed many persons are never better than when they are passing an excess of the lithates. When, however, it is deposited as an amorphous sediment in the bladder, the last portions of urine are so loaded with it, that the patient apprehends he is passing blood. In this case, in the first instance, he is only troubled with itching and pain in the urethra in making water; but if the disease becomes chronic the bladder becomes irritable, the urine loaded with mucus, the healthy sympathy between the bladder and prostate is destroyed, so that the urine is only passed after great forcing, and in trifling quantity, and his sufferings are singularly painful and severe. The secretion of a great excess of the lithates is seldom a purely local disease, but is usually vicarious of, or accompanied by, some more general affection, as cardialgia, asthma, palpitation of the heart, rheumatism, or gout; and during its continuance these diseases often, in a great measure, subside.

Although the passage of an amorphous sediment, unless it be in such quantity as absolutely to obstruct the passage, is seldom productive of much local inconvenience, unless it be of long continuance; yet when the lithic acid crystallizes so as to form gravel, or a still larger concretion, the expulsion of this foreign body is always attended with much pain, and gives rise to what has been termed nephritic colic.

Colica Nephritica.—The passage of a calculus from the kidney into the bladder may be preceded by dull pains in the back and some sickness; but more commonly the attack is sudden, and the patient, perhaps, in his best health, and engaged in the ordinary transactions of life, is on the instant seized with excruciating agony in the loins, with retractation of the testicle, irritation of the bladder, and often with nausea and vomiting; but in all this suffering the pulse retains its healthy frequency, and the heat of the body is natural. At length the pain intermits, and the patient has a short interval of ease. The paroxysm, however, returns more or less frequently, till the patient is relieved as by a charm, the calculus having passed into the bladder. Again, after an uncertain interval, the gravel or calculus becomes impacted in the neck of the bladder, when the same phenomena present themselves, but have a different locality, or the urethra, till at last, after an effort to pass water, the noise of a stone falling into the chamber-vessel is heard, and the gravel or calculus is found.

The duration of this fit is very various, lasting perhaps from one hour to many, and sometimes continuing for many days. Occasionally, however, the calculus has acquired so great a magnitude that it becomes impacted in the ureters and death has ensued from this cause. In general, calculi pass from one kidney only at a time, but sometimes they pass simultaneously from both kidneys; and should they be large, or the passage long, an entire suppression of urine has been the consequence, and the patient has fallen from that cause.

Sometimes the calculus so rapidly increases by sedimentary deposits that it is detained altogether in the kidney, when it not only takes the form of the pelvis of the kidney, but branches out in every direction like a piece of ginger. In a few instances, a calculus thus formed in the kidney may lie latent and cause little inconvenience to the patient, as in the case of the daughter of Sir Richard Steele, who was found to have one of these large calculi in the kidney, although she had made no complaint referable to that organ during life. More commonly, however, the calculus acts as a foreign body, and the kidney becomes the seat of abscess or other disorganization, and the patient suffers immensely with pains in the back, irritability of the bladder, aggravated by the frequent discharge of pus, of blood, or mucus. Existence under these circumstances becomes a burthen; and death, long prayed for, at length terminates the patient's ceaseless sufferings.

A calculus having passed into the bladder sometimes increases so fast that it acquires a magnitude too great to escape by the urethra, and in this case a stone in the bladder is formed; and this disease, as it necessarily requires an operation, will be found treated of under the head of surgery.

Diagnosis.—The red lithates can alone be confounded with blood, and from which, when intense in colour, they often can with difficulty be distinguished. On cooling, however, the subsidence of an impalpable or gritty deposit, the presence generally of much mucus, the absence of fibrine, and also of albumen, when the urine is treated by nitric acid, enable us readily to distinguish them. The white or light-coloured lithates are distinguished from the phosphates by the urine being acid, by the absence of the abundant mucous discharge which always accompanies a large deposition of the phosphates, and from the urine not becoming alkaline or fœtid if kept for a few hours. The precipitated lithates also are readily dissolvable by heat, which the phosphates are not.

Prognosis.—While the deposits are yet but sedimentary, the prognosis is always favourable, however large the quantity discharged. Even when gravel or small calculi are formed, the chances are very many that it will be discharged before it attains any considerable size. When the calculus is so large, however, as to be retained in the kidney or ureter, the disease is necessarily fatal. Also, when retained in the bladder, nothing but a surgical operation can remove it; and consequently the chances resolve themselves into the proportionate numbers which recover or fall after the operation of lithotrity or lithotomy at the age and under the circumstances of the patient.

Treatment.—The medical treatment of the lithic acid diathesis is extremely well determined, or by alkalies or neutral salts, turpentine, and saccharine matters.

The celebrated Morgagni suffered greatly from lithic acid gravel, and his remedy was, half a drachm of carbonate of potash night and morning, gradually increasing the dose till he took three drachms during the day. "The acid of his urine," he states, "soon became saturated, the pain in his loins diminished, his urine became less loaded, and potash was at length found in that fluid in excess." He also adds, "I have repeated this remedy as often as I have been threatened with an attack, and always with success." The particular salt, however, is not perhaps of great moment, for Sir Gilbert Blane found his patients much benefited by the citrate of potash, or the common effervescing draught. When the patient's bowels require a more active agent, the sulphate of magnesia, the sulphate of soda, or the iodide or bromide of potash may be substituted.

The pure alkalies, from the much smaller doses in which they can only be administered, are much less beneficial than the neutral salts. Magnesia, also, in Mr. Brande's experiments, produced much less marked effects on the urine than either the subcarbonate of potash or soda, while lime-water produced no very sensible effect whatever.

Besides alkalies, turpentine has some character in the cure of the lithic acid diathesis. The celebrated Dutch drops are supposed to be principally composed of sp. terebinthinæ and of tinct. opii, coloured by petroleum. Dr. Henry gives two cases of the beneficial effects of this remedy. One of them was a lady, who, when threatened with an attack, always had recourse to it, and the uniform effect was the discharge of a sandy substance in such quantities that often four ounces were discharged in two or three days. The other instance is of a similar description.

The above-mentioned treatment is often successful; but there are cases in which it fails, and the patient continues to be tormented for months with little relief. In these instances, the inf. diosmæ or the pulv. uva ursi may be tried, combined with some mild opiate, which latter substance always gives relief.

If the urinary sediment should concrete into gravel, an attack of nephritic colic may take place. The treatment of this attack is the same as for the passage of a gall-stone; or the warm bath, mild purgatives, and opiates. The inexperienced practitioner should be cautioned against the use of blisters lest the absorption of the peculiar principle of the lyttæ should occasion stranguary.

If the calculus, having escaped from the kidney, is retained in the bladder, an operation for its removal is necessary, and the case now becomes purely surgical.

Dietetic Treatment.—The dietetic treatment is of the greatest importance in the cure of the lithic acid diathesis. The experiments of Wollaston and Vauquelin have shown that in proportion as animals are fed on animal diet or on azoted substances, their urine becomes more and more loaded with lithic acid. While Majendie has shown by a counterproof, if a dog be fed on non-azoted substances, as sugar, every trace of lithic acid disappears from the urine. A lady at Paris, suffering from gravel, having heard of Majendie's experiments, made trial of sugar on herself, eating more than a pound daily. She persevered in this regimen for six weeks, when her gravel disappeared. She now returned to her old regimen, and at the end of three months her fits of gravel returned.

It is plain, therefore, that the quantity of animal food should be reduced. It is necessary also that port as well as French wines should be abandoned, as well as all those things which, according to the idiosyncrasy of the patient, are likely to produce indigestion or acidity of the stomach. The patient also should be warmly clad, rise early, and take a considerable portion of exercise.

Ceramuria or *Phosphatic Diathesis.*—The phosphates are secreted in a state of health in the proportion of one part in 1000 of urine. When this proportion is abnormally increased, so that they are largely deposited either in the kidney or bladder, or even in the chamber-vessel, they produce the disease termed the phosphatic diathesis.

Remote Cause.—The remote causes of this affection are exposure to cold and wet, poor diet, blows on the back, and more especially diseases of the bladder, as vesical catarrh, stone in the bladder, the introduction of a bougie, or other irritating cause.

Predisposing Cause.—This form of disease sometimes occurs in children, but more commonly in adults between thirty and forty years of age. It affects both sexes, but more commonly the male than the female. The party affected is usually of an asthenic, pale, leucophlegmatic temperament, and in most instances is supposed to have inherited it.

Pathology.—This affection, though often resulting from disease of the bladder or kidney, yet occasionally exists when no such disease is present, and consequently is essentially a disease of function. It is the prevalence of this diathesis that causes those large calculi sometimes found in the kidney or bladder.

The elements of this diathesis exist in the blood; for the red particles, the albumen and fibrine, when burnt, all yield a small portion of the earthy phosphates. Berzelius is of opinion that, previous to incineration, they exist in the blood in the states of phosphorus, of calcium, of magnesium, of sodium, and of potassium

Elementary Principles of Medicine.

the office of the kidney being to acidify the phosphorus and combine the phosphoric acid with these different bases, according to their affinities and quantities. In healthy urine these salts exist in the state of the biphosphates, and in the proportion of one part in 1000. So that, supposing one part of these salts to be soluble in 480 parts of urine at 60°, the solvent at 98° is about two-thirds in excess. These salts, like the super-lithates, have the property of reddening vegetable blues, and they show an acid re-action. When the earthy bases of lime or magnesia are from any cause secreted in greater abundance than natural, they combine with the biphosphates, which are now thrown down in the form of insoluble phosphates, and which may be deposited either as a sediment on the urine cooling, or in the bladder or kidney before being passed, or else being retained in those cavities may concrete into a stone or calculus.

Symptoms.—When this diathesis is a primary affection, the party is usually of a sallow complexion, stout, but effeminate, and of great irritability of nerve. He also suffers from indigestion, flatulence, constipated or disordered bowels, his stools being either black or clay-coloured. His bladder also is highly irritable; he has a pain in his back and loins; his urine is abundant and loaded with mucus, together with a copious white sediment, so that the latter portions of urine pass like so much milk.

The duration of this disease is often very chronic, on account of the diseased state of the bladder, with which it is connected. In cases, however, in which that viscus is healthy, it often readily yields to medical treatment; but in other instances, when all appears to be proceeding favourably, the lungs become affected and the patient dies of phthisis.

The urine, when examined, is pale, increased in quantity, often turbid, and covered with an iridescent pellicle or film, consisting of a solution of the triple phosphate of ammonia and magnesia; much mucus is also deposited, together with a most copious precipitate of the phosphates, so that sometimes the urine appears like so much chalk and water. It is singular, however, that although the urine is so loaded with foreign matters, it is generally of low specific gravity, or 1001, 1002, or 1003.

As the phosphates have little tendency to crystallize, a nucleus is necessary before the sediment can concrete into calculi; and it is in this form of disease that we find such singular substances in their centres, as a clot of blood, a piece of hardened mucus, broken ends of sounds or bougies, bits of straw, bodkins, pins, plumstones, beans, nut-shells, and bullets.

The calculi which form on these nuclei are of three descriptions and in the following proportions. Out of 108 calculi examined there were of—

Phosphate of lime, nearly pure . .	8
Triple phosphate, or phosphate of ammonia and magnesia . . .	3
Mixed or fusible calculi, being a mixture of the two preceding .	91
	102

These calculi are distinguished from all other calculi in being soluble in an excess of phosphoric acid. They are distinguished from one another by the phosphate of lime calculus being nearly infusible, by the mixed being readily fusible, while the triple phosphate is known by the minute crystals which often form between the interstices of the laminæ.

Every other form of calculus, whether the lithate or the oxalate, from the irritation it occasions, constantly produces a deposit of a soft coating of the phosphates. When, however, the phosphatic deposition is once well established, it is seldom followed by the deposition of strata of any other description. Thus of 823 calculi examined by Dr. Prout, he found only three specimens in which the phosphates had been followed or surrounded by other calculous deposits; and hence he deduces the important law, that a decided deposition of the phosphates is not followed by one of any other description.

The physical characters of the phosphatic calculi are, that they are white, soft, and easily broken down, and are deposited in concentric laminæ like the lithic acid concretions.

Diagnosis.—The phosphatic sediments may be distinguished from the lithic by the urine, though at first acid, becoming putrescent, and giving an alkaline reaction after standing a few hours. Ammonia also added to the urine throws down a white cloud, which consists of the phosphate of lime with some of the ammoniaco-magnesian phosphates, a test which would render the lithates soluble. The best test, however, is the addition of phosphoric acid, which would re-dissolve the precipitate.

Prognosis.—When this diathesis is unaccompanied by disease of the bladder the prognosis is always favourable. When, however, it results from a morbid state of the bladder or diseased structure of the kidney, the disease is always of long duration. Should metastasis take place to the lungs the disease is fatal.

Treatment.—The treatment of this affection is by some mineral acid combined with an opiate. The acid is not very important; and the nitric, muriatic, the phosphatic, or the sulphuric are equally beneficial; but the dilute sulphuric acid is generally preferred as being most pleasant to the taste. The most usual remedy therefore is the infusi rosæ, with an addition of ♏v. to ♏x. of dilute sulphuric acid, together with tinct. opii ♏iij. to ♏v. every six hours. This combination is generally so powerful in checking this affection, that the sulphate of magnesia may be added to it if the bowels should require to be regulated.

When the phosphatic diathesis depends on vesical catarrh, or other diseased state of the bladder, salicinæ gr. x. ter die has occasionally been found successful. Others prefer the inf. diosmæ, and others uva ursi. It is decidedly bad practice to use the pure alkalies in these cases.

Dietetic Treatment.—The diet should be as nourishing as the state of the diseased viscus will allow; and acid, wines, and ripe fruits greatly assist in effecting the cure.

Oxaluria—Is that diseased function of the kidney by which oxalate of lime is secreted, a fact first determined by Dr. Wollaston.

Remote Cause.—The remote cause of this disease is not determined, for persons in the best health will often void an oxalate of lime calculus. It is supposed, however, to be most frequent among those who eat largely of common sorrel (rumex acetosa), or of tomata (solanum lycopersicum), and of the leaf-stalk of the rhubarb plant, all of which many persons are passionately fond, and all of which contain oxalic acid.

Elementary Principles of Medicine.

Predisposing Causes.—This form of disease may exist before puberty, and from that period till sixty, beyond which age Dr. Prout has met with no case. It is most usual, however, between forty and fifty. It attacks both sexes, and is not incompatible with gout.

Pathology.—This disease is decidedly a disease of function, and not connected with any known alteration of the structure of the kidney.

Oxalic acid being composed of carbon 33·99, and of oxygen 53·33, the elements of this acid exist abundantly in the blood, and probably in many instances this formation takes place entirely from a vitiated action of the kidney. The experiments of Woehler, however, have, he thinks, proved beyond a doubt that the oxalic is one of the few acids that make their way into the torrent of the circulation, and are eliminated, both free and combined with a base, from the kidney. He caused a dog to swallow two drachms of oxalic acid mixed with a quantity of bread and meat, and on examining the urine it was found to deposit a precipitate on cooling, and a further precipitate on the addition of nitrate of lime. On both precipitates being collected, they were found to consist of oxalate of lime, almost demonstrating that the oxalic acid must have been carried directly from the stomach to the kidney.

The oxalate of lime very rarely appears under the form of an amorphous sediment; still it has occurred mixed with the lithic amorphous sediments, but even this is uncommon. Its appearance is still more rare under the form of crystallized gravel, so much so that Dr. Prout mentions only two instances. Renal calculi of this formation are not very uncommon, since Dr. Prout mentions having met with twelve cases. When detained in the bladder they often acquire a considerable size, are rugged, dark-coloured, and tuberculated, and from these appearances have been termed the "mulberry calculi." Oxalate of lime enters as a constituent part into about one-fourth of all the calculi examined. The following table will show the different transitions:—

Oxalate of lime.	113
Lithic and mulberry . . .	15
Mulberry and lithic . . .	40
Mulberry and phosphates . .	49
Fusible and mulberry . . .	2
	219

When heated before the blow-pipe the oxalic acid is decomposed, and pure lime remains, which gives a strong brown stain to moistened turmeric paper. This calculus is insoluble in the alkalies, but by digestion in carbonate of potash it is decomposed, and the insoluble carbonate of lime is left. When reduced to powder and digested in nitric or muriatic acids a perfect solution is effected. It is not dissolved by acetic acid—a circumstance which distinguishes it from the ammoniaco-magnesian phosphate. It is distinguished from the phosphate of lime by being insoluble in phosphoric acid.

Symptoms.—This disease is attended with no prominent feature. The urine, which contains this substance, is acid, of a good colour and remarkably pure, and free from all sorts of sediment as well as gravel. The patient is therefore hardly sensible of any inconvenience till he is attacked by a fit of nephritic colic, caused by the passage of the calculus from the kidney or bladder, or else till he is troubled, supposing it to be retained, by symptoms of stone in the bladder or kidney.

Diagnosis.—The mode in which this calculus may be distinguished from all others has been already described.

Prognosis.—It is seldom that a second calculus of the oxalate of lime exists in the kidney after one has been passed. When it is detained in the bladder the patient is of course submitted to the accidents of a surgical operation.

Treatment.—Very little is known respecting the medical treatment of this calculus. Dr. Prout recommends, after passing a mulberry calculus, that we should induce a lithic acid diathesis; but it must be questionable whether the disease substituted is not as dangerous as the one under which the patient originally laboured. He speaks, however, of having seen much advantage derived from mineral acids and the sulphates of iron or of quina. The fixed alkalies often do absolute mischief.

Dietetic Treatment.—The patient should carefully avoid eating all substances containing oxalic acid. A gentleman who had lived as a *bon-vivant*, determined to reform his diet, but to render his new dishes more palatable, he ate every day a plateful of sorrel, and was attacked with an oxalate of lime calculus.

Cystinuria.—The cystic oxyde was described by its discoverer, Dr. Wollaston, in the 'Philosophical Transactions for 1810;' and from the similarity which this substance bears to certain oxydes in uniting both with alkalies and acids, Dr. Wollaston termed it an oxyde, and gave it the name of cystic oxyde, on the supposition of its being peculiar to the bladder. Dr. Marcet, however, has found it in the kidney. This substance has only in a few instances been discovered, but is suspected by Dr. Prout not to be infrequent.

Remote Cause.—The remote cause of this disease is entirely unknown.

Predisposing Causes.—The first calculus examined by Dr. Wollaston of this description was taken from a boy five years old. It has been found also in the adult; and Professor Stromeyer found it in two instances in one family, and it is supposed also to be hereditary.

Pathology.—The cystic oxyde diathesis is probably a disease of function, but in most of the instances examined at present, the kidneys have been found diseased. An analysis of this concretion by Lassaigne gives—

Carbon . . .	36·2
Hydrogen . .	12·8
Oxygen . . .	17
Nitrogen. . .	34
	100

The elements of cystic oxyde, therefore, exist plentifully in the blood. This substance appears to result from an original diathesis, and has been discovered in the urine in a state of solution, of mechanical suspension, and also in the solid form of a calculus, either pure or else incrusted with the phosphates or lithates. The concretion, when pure, is not laminated, but appears as one uniform mass confusedly crystallized through its whole substance, having somewhat of the appearance of the ammoniaco-magnesian phosphate, though more compact. Before the blow-pipe it emits a peculiarly fœtid smell, quite distinct from that of uric acid, and is consumed. It is characterized by the great variety of re-agents in which it is soluble. It is dissolved abundantly by the muriatic, nitric, sulphuric, and oxalic acids; by potash, soda, and ammonia, and even by the neutral carbonates of soda and potash. It is insoluble in water, alcohol, bicarbonate of

ammonia, and in the tartaric, citric, and acetic acids. The urine in which this substance has been found was copious, of a yellowish green, of a strong peculiar smell, and of a low specific gravity, or 101148; it was entirely free from uric acid, and the urea deficient in quantity. This diathesis is of unfavourable prognosis, and its mode of treatment not yet determined.

Xanthuria is only known by the occasional existence of an exceedingly rare calculus, first discovered by Dr. Marcet, and has since been met with by Liebig and Woehler, and also by Professor Langenbeck, of Gottingen. Its chemical characters are hardly determined, but it turns yellow when treated with nitric acid, and it is supposed to be formed of the same elements and in the same proportions as lithic acid, only minus one atom of oxygen. The causes of this disease, as well as its treatment, are at present very obscure.

Dr. Marcet has also described a variety of calculus under the name of *fibrinous* calculus, which appears to be composed of the fibrine of the blood. Sir Benjamin Brodie has met with one specimen of this formation. It was of an oval shape, about the size of a horse-bean, yellow, semitransparent, not very unlike amber in appearance, but less hard. When dry it shrivelled up. Dr. Hodgkin found in the bladder of a boy after death a concretion which consisted of concentric layers of a white elastic substance, like coagulated albumen, and between each layer was a thin strata of very friable earthy matter, probably phosphate of lime. Nothing further is known of this unusual disease.

Of the Diseases of Function of the Uterus.

The functional diseases of the uterus are leucorrhœa, amenorrhœa, and its variety, chlorosis, and also dysmenorrhœa. This class of disease has been known since medicine was a science.

Of Leucorrhœa.

Leucorrhœa is a white or nearly white discharge from the vagina, unattended with pain.

Remote Cause.—This affection may arise from all those moral or physical causes which depress the system generally, and which act so powerfully on the frames of delicate females, as any severe mental suffering, the depression which follows high excitement, exhaustion caused by hot rooms, sudden or great changes of temperature, deficient nourishment, or, on the contrary, too stimulating a diet. Leucorrhœa, likewise, has many local causes, as the irritation and weakness caused by abortion or child-bearing, and in the latter case it often continues during the period of suckling.

Predisposing Causes.—Leucorrhœa is occasionally seen in young children, but is only common to adult age. It may attack women at all periods of life, but is most frequent from sixteen to twenty-five. It is a disease to which females of every temperament are subject; for, of nineteen cases given by Marc d'Espine, six were robust, nine moderately strong, and four only were sickly.

It is not uncommon to find the "whites" in young females occurring monthly, for a short time preceding the development of the catamenia, and for a few months after their appearance. At a later period of life a similar discharge often takes place at regular times in women labouring under amenorrhœa, and often continues until the natural secretion is restored. Leucorrhœa is also common in many women during the intervals of menstruation; and in these cases the discharge may increase for two or three days previous to the appearance of the menses, cease during their flow, but reappear after their subsidence. In other cases leucorrhœa alternates with menorrhagia.

Pathology.—The leucorrhœal discharge may proceed from the uterus, the vagina, or from both; but the structure of these parts, with very few exceptions, is perfectly healthy. Marc d'Espine* has shown this to be the case by a number of examinations made by the speculum; for he found the orifice of the uterus perfectly healthy in fifty-three cases, slightly red in thirty-five cases, and red and granulated in twenty-five cases. This disease is therefore strictly a disease of function. It has been asked whether this discharge is secreted by the mucous follicles, or by the web of the mucous membrane, supposing the uterus to possess one; and it seems most probable both systems are faulty in this affection. The pain under the left breast, which so often accompanies leucorrhœa, cannot be accounted for by any structural lesion, neither by any direct nervous sympathy. Valleix conceives it to be a dorso-costal neuralgia, but is unable to explain its occurrence as a symptom of this affection.

Symptoms.—The leucorrhœal discharge is usually of a bland muciform nature, and probably contains some albumen. Its quantity is often so considerable as to wet several napkins in the twenty-four hours; its consistency is various, or from a transparent and almost aqueous discharge to one of considerable thickness and opacity, while its colour differs from nearly a pure white to a blue or yellow.

The patient is not sensible of any increase of local heat, pain, or tenderness in the part from which the discharge proceeds; but her constitution is generally languid and weak, her complexion pale and sallow, and often with a dark areola under her eye. She complains of pain in her back, but the more characteristic symptom is a pain on the left side, sometimes on the right, and occasionally on both sides, and which is often constant, severe, and distressing. The tongue is generally clean, the pulse quick and irritable, and the bowels constipated. In a few cases the constitution sympathises more actively, and in these instances syncope, hysteria, and perhaps some local irritation, as bearing down, is present.

The duration of leucorrhœa is very various, but it seldom lasts longer than from two weeks to two months under medical treatment; but if left to itself, it is often many months in subsiding.

Diagnosis.—Leucorrhœa is distinguished from gonorrhœa by the moral character of the party, by the absence of all local pain, by the whiteness of the discharge, and by the pain in the side, which is often mistaken for pleurisy or for hepatitis, and the patient is sadly punished in consequence. In nineteen cases out of twenty, however, the existence of the leucorrhœa is sufficient to determine the harmless nature of the pain.

Prognosis.—The prognosis is in every instance most favourable.

Treatment.—The treatment may be general or local, or both conjoined. A large number of cases readily yield to a general treatment by the mineral acids. The infusi rosæ ℥xj. sp. ætheris nitrici ʒj., to which may be added magnesiæ sulphatis ʒj. should the bowels be costive, and also tinct. hyoscyami ♏xv. if there should be pain in the side, ter die, is a prescription very often

* *Archives Générales.* February, 1836.

successful. In the more obstinate cases the draught may be strengthened by ♏iij. to ♏v. of dilute sulphuric acid. If the patient at the same time be labouring under amenorrhœa, one to three grains of the sulphate of iron may be substituted for the æther; or, what is still better, ten grains of salicine three times a day. The cold bath, horse exercise, and country air are desirable adjuvants.

When the disease has resisted general remedies, some local treatment is necessary, and this consists of astringent injections thrown up the vagina by a syringe or India-rubber bottle. The most popular injections are the decoctum querci, or a drachm of alum dissolved in four ounces of water, or else a drachm of the sulphate of zinc to the same quantity of water, or ten to twenty grains of the nitrate of silver in the same quantity of distilled water. These injections should be administered slowly, the patient being in a recumbent posture. They seldom give any pain. Some difference of opinion exists as to the form of disease in which they are useful, for some practitioners rely almost entirely on them for the cure of vaginal leucorrhœa, but consider them as highly injurious when the discharge takes place from the uterus; while others use them in every case.

In very acute forms of leucorrhœa cupping from the loins, or leeches to the lower portion of the abdomen, are useful, and after this hip-baths and vaginal injections of warm water may be employed till the severity of the attack has subsided.

Dietetic treatment.—The diet in most cases of leucorrhœa should be light and nutritious, and a glass or two of some French or Rhenish wine greatly assists the patient's recovery.

Of Amenorrhœa.

Amenorrhœa is a partial or total suppression of the menstrual discharge at the usual periods.

Remote Cause.—Amenorrhœa arises, like leucorrhœa, in some women from great delicacy of constitution; in others from the luxurious routine of a London life. There are likewise many other more direct causes, as taking cold during the term of menstruation, and especially by getting wet in the feet. Any powerful mental or physical shock received during the same period is also a cause. Amenorrhœa is also a consequence of most severe disorders, as fever or phthisis.

Predisposing Causes.—It is difficult to say at what age, taking the extremes of adult life, a party may be said to labour under amenorrhœa, for great differences exist as to the time of commencement of the first menstruation and the termination of the last.

It may be stated, however, that the most general age of puberty in the female is about fifteen, and also that rather before fifty this sexual function ceases. Amenorrhœa is perhaps most common at these two extremes of adult age. In young women, for example, the first appearance of menstruation is often followed by an intermission of two, three, or more periods, after which this function is regularly performed unless some disturbing cause suppresses it. The middle periods of life are in most women occupied between pregnancy and suckling, so that a considerable portion of life is thus passed in a state of natural amenorrhœa. Towards the close of the menstrual period, however, the functions of the uterus are more feebly performed, and during the last three or four years menstruation often intermits, returns, and then ceases altogether.

Pathology.—In amenorrhœa the uterus retains its healthy structure. The only sensible difference is that the cervix is perhaps smaller and more pointed, but at the proper periods even this enlarges and assumes the natural and healthy form incident to that time. Amenorrhœa is consequently a result of mere disordered function of the uterus.

Amenorrhœa, besides being a mere functional disease, sometimes arises from congenital malformation; thus the uterus may be wanting, or it may be irregularly or incompletely developed. The canal in the cervix may be imperforate; there may be a membrane covering the os uteri; the vagina may be wanting, its sides adherent, or its orifice closed by adhesion, a false membrane, or an imperforate hymen. The ovaries also have, in some instances, been found wanting; nevertheless the persons in whom this defect occurs are in other respects well formed and healthy, and all the organic functions, save the one in question, fully performed. The bosom, however, of such women is not prominent, their voice is deeper than is usual, and a slight beard appears on the upper lip, so that there is a mixture of masculine and feminine peculiarities both of person and character in these individuals.

Symptoms.—Amenorrhœa may be partial or total, that is, the menses may be deficient in quantity or be delayed as to time, or may be altogether suppressed for one or more periods.

When amenorrhœa is partial the quantity may be smaller than usual. Thus the mean quantity lost amounts to about four ounces; but it may now be reduced to a mere show, and hardly soil more than one or two napkins. It may also be defective as to quality, being often much paler than usual. Again, amenorrhœa may be partial as to time, the menses appearing only every five or six weeks instead of every month. Again, the amenorrhœa may be total, the discharge not taking place perhaps till after the lapse of one, two, or more periods. Whichever form amenorrhœa may assume, the symptoms are nearly the same, and are usually divided into acute and chronic.

Acute amenorrhœa generally takes place from some cause acting immediately previous to or during the menstrual period, such as exposure to cold or wet, anxiety, fright, or an attack of fever or other severe disorder. In this case there is considerable febrile action, flushed face, a quick pulse, great pain in the back and side, and often much local suffering; while instances are known in highly excitable females of this apparently trifling affection terminating in insanity.

Chronic amenorrhœa is generally the result of much constitutional debility, and the patient at the usual mensual period has shivering; pain in the back and loins, and down the thighs; weight at the lower part of the abdomen, together with great lassitude and depression. These symptoms, having lasted a day or two, pass away without any menstrual secretion, and are repeated each succeeding month till there is a return to a healthy state. But the effects of this abortion are not so temporary, for in the intervals severe headache, throbbing, and a sense of fulness in the temples and pain in the left side are for the most part present. The appetite also is impaired, the bowels irregular, the countenance pale, the strength much reduced, together with paroxysms of hysteria or of palpitation.

The most exquisite form of chronic amenorrhœa, however, is *chlorosis*, or the *green* sickness. In this

case, in addition to the previous symptoms, the countenance is singularly sallow, or of a yellowish green, and bloated, and the legs œdematous, with in general much arterial action, producing in the carotids the "bruit du diable." In many of these cases also the appetite becomes singularly morbid and depraved, while the patient's strength and spirits are depressed in the extreme; she is readily overcome, and bursts into tears on the slightest emotion, and generally passes much time in her room.

Amenorrhœa is sometimes accompanied by a vicarious hæmorrhage from some remote organ, and generally from the stomach, lungs, or nostrils; but cases are recorded in which it has burst forth from the eyes, ears, gums, arms, bladder, nipples, the ends of the fingers and toes, from the joints, the axilla, the stump of an amputated limb, from ulcers, varicose tumors, and from the surface of the skin generally. The attack in these cases comes on suddenly, and continues at intervals for some days, unless the quantity be very great, in which case there is only one hæmorrhage. The local and perhaps constitutional distress under which the patient laboured may have been thus relieved, but her health is not re-established in the interval. Vicarious hæmorrhage, instead of occurring every month, sometimes alternates monthly with the catamenia, and sometimes again it only occurs after long periods, so as to appear quite accidental.

Instead of vicarious hæmorrhage, it sometimes happens, when the patient's health has suffered greatly, that the leucorrhœal discharge has appeared at the regular periods, instead of the menses, and this for many successive periods, greatly adding to the nervous sensibility which so remarkably characterizes this disease, and giving rise to the most exquisite forms of hysteria.

Diagnosis.—The points involved in the diagnosis are, whether the amenorrhœa is the result of pregnancy, or of congenital malformation, and these cases can be readily determined by an examination. It should be remembered that there are endless instances of a woman bearing many children successively without menstruating, the impregnation taking place during lactation. Professor Frank also gives the case of a woman who bore three children, without having menstruated either previously to her marriage or subsequently to the birth of the children.

Prognosis.—Amenorrhœa is itself void of danger, unless it denotes the existence of some disease of a fatal character, as phthisis. At the "turn of life" it is sometimes succeeded by ovarian or uterine disease.

Treatment.—When a sudden suppression of menstruation has taken place, as in acute amenorrhœa, the natural flow is often re-established by placing the patient's feet in warm water, or else by placing her in a warm hip-bath, and exhibiting some diaphoretic medicine or drink at bed-time, when the discharge often returns in a few hours. If, however, it should be accompanied by fever, headache, and a quick pulse, dry skin, and heated tongue, some blood should be taken from the arm; a saline purgative, combined with a mild opiate, should be exhibited ter die, and hot fomentations be applied to the abdomen.

The chronic forms of amenorrhœa are best treated by tonics; and there is no class of medicines which have not maintained much reputation in this complaint, as musk, castor, camphor, or the vegetable and mineral tonics. Dr. Locock speaks of the combination of myrrh, aloes, sulphate of iron, and of the essential oil of savine, as having been highly useful in his practice. (Cyclopædia of Medicine.) In general the amenorrhœa is best treated with salicine, gr. x. ter die, or with preparations of iron, as the citrate of iron, gr. x. ter die, or Griffith's mixture; but the salicine less frequently disappoints the hopes of the practitioner than the iron, and does not heat the patient or cause headache. When the bowels are extremely confined the decoct. aloes ℥ fs. to ℥ j. ter die may sometimes be substituted for or taken in conjunction with the other medicines. If these remedies should fail, a wide field of experiment is laid open to the practitioner. Dr. Bardesley, for instance, recommends strychnia one-tenth to one-quarter of a grain, a remedy unquestionably of great danger and of little benefit; while others recommend savine, tinct. cantharides ♏ xxv. ter die, the turpentines, balsams, or guaiacum. The patient, however, had better repair to some of the natural mineral springs, as Tunbridge Wells or Cheltenham, where she can have wholesome air and exercise, rather than submit to so endless a series of medicamentations.

Dysmenorrhœa, or Hysteralgia,

Is that affection in which the periods of menstruation are attended with great pain.

Remote Causes.—This affection, often constitutional, is common to barren, to epileptic, or to highly hysterical women. It sometimes arises, however, from fright, or other cause which suspends the flow of the menses.

Predisposing Causes.—Dysmenorrhœa is rare before the body has acquired its full growth, and is most common between twenty and thirty-five. It necessarily ceases during pregnancy and suckling, but it returns and marks the few last years of menstruation. It occurs most frequently in women of a nervous sanguine temperament, and of strong passions, and it is said more especially to affect those devoted to a monastic life.

Pathology.—Dysmenorrhœa unquestionably accompanies most structural diseases of the womb, but structural diseases of the womb are rare till after forty. This form of uterine disease, therefore, in the great majority of cases is purely functional.

Symptoms.—Catamenial hysteralgia commences most commonly two, three, or more days before menstruation. The symptoms are lumbar pains, increased by the patient attempting to stand, and also pains of the hypogastrium and umbilicus. These pains have different characters and intensities, and are described as lancinating, or stabbing, or constricted, and as if the abdomen was grasped by a powerful hand. The patient from her sufferings being unable to walk, her digestive functions are generally deranged, and her bowels constipated or otherwise affected. The mammæ also enlarge and are painful, the genital organs are swollen, a mucous discharge takes place from the vagina, the passage of urine is attended with heat, and in some cases both the bladder and rectum sympathize, and are irritable.

These symptoms increase as the period approaches, when they sometimes suddenly cease, but at other times they continue till the menstrual flux decreases, and then are mitigated. The flow is often trifling and so defective in quality and quantity as to be little more than a reddish serosity, or, being abundant, it may suddenly cease and return some days after. In other cases it is profuse, almost amounting to hæmorrhage. In the intervals, in many cases, the patient enjoys good

Elementary Principles of Medicine.

health; in other cases, the pains, though mitigated, are aroused on the slightest motion, while in a very few some inflammation of the uterus, extending perhaps to the ovaries, may take place.

Diagnosis.—The coincidence of the attack with the periodic flow, and its subsidence after its cessation, are sufficient diagnostic symptoms of this affection.

Prognosis.—The symptoms of hysteralgia are sometimes so intense as to alarm and distress both the patient and her family, but life is never compromised, and the prognosis is consequently always favourable.

Treatment.—There are few diseases more distressing to the patient than hysteralgia, or that are altogether less under the control of medicine. During the period. however, a warm hip-bath, an opiate, and the mist. camphoræ c. sp. ætheris nitrici often afford great relief, and in recent cases of great severity some blood may be taken by cupping from the loins. In the interval the pains, it has been stated, are often mitigated, but nevertheless they are still often reproduced by every attempt to walk, and the patient is perhaps for many months confined to the sofa. Under these circumstances experience has shown that bleeding is not only of no use, but that, for the most part, it is absolutely injurious; neither do blisters produce any satisfactory results. We have, however, some resource in stimulant medicines, as camphor gr. v. to x. ter die; in the mistura assafœtidæ ℥ fs. to ℥ j. ter die; also in salicine, iron, castor, musk, warm purgatives, and quina; and all these perhaps give relief in turn, but all at length perhaps equally fail, showing that they act rather on the mind than on the body. From this cause we should recommend change of scene, of air, and of society, together with cold bathing in the morning during the intervals, and warm baths at the particular periods. Such exercise, also, on horseback as the patient can take she should be permitted to indulge in, and her mind should be amused in every possible manner. At length these miseries subside or are suspended by marriage, pregnancy, suckling, or the approach of the "time of life." The worst cases are those which are connected with disease of the heart or with epilepsy, and in these instances no permanent relief is obtained unless the primary disease subsides.

Of Hæmorrhages.—Order II.

Hæmorrhage is the effusion of blood into the substance of an organ, or else from some tissue of the body, and more especially from the cellular and mucous tissues. It may take place from the rupture of a blood-vessel, whether caused by a simple solution of continuity, or by an abscess or other form of ulcer. More commonly, however, hæmorrhage takes place from the capillary vessels of the part, without any rupture of vessel or breach of surface, and this latter form is that which occurs in ninety-nine cases in a hundred. The blood effused may be either venous or arterial, and the symptoms it gives rise to depend on the organ affected and the quantity of blood lost.

Hæmorrhage may be caused by a diseased action of the solids, and in this case it may be active or passive. It is passive, for instance, when it takes place in consequence of a blow which impairs the vitality of the part and allows the escape of blood into the surrounding tissues. It is passive also when the heart acts so powerfully as to overcome the capillaries of the part. There are many circumstances, however, in which it is evidently active, as in menstruation, in vicarious hæmorrhage, in some cases of inflammation, and also in many of those cases in which it is the prelude to phthisis. There are a certain number of hæmorrhages also which do not appear to originate in a primary diseased action of the solids, but which seem to result from an altered condition of the blood. Thus hæmorrhages are common when the blood contains less fibrine than in health, as in typhus and in scurvy, while they are rare in diseases in which the blood contains an excess of fibrine, as in inflammation or chlorosis. This diminution of fibrine in cases of hæmorrhage is so constant that Andral conceives it impossible not to regard the one as the cause of the other. In hæmorrhage from plethora he conceives that the fibrine remaining the same, or being diminished, the blood contains a larger proportion of red globules than in health; while in scurvy, or other depressed states of the system, the fibrine is alone diminished, the red globules remaining in normal proportion. In general, in hæmorrhage, the blood is not buffed, has a large soft clot, and if the hæmorrhage has been considerable, with difficulty coagulates, showing a diminished quantity of fibrine. Many substances also which directly contaminate the blood have the power to produce hæmorrhage. A solution of sub-carbonate of soda, injected into the veins of animals, deprives the blood entirely of the power of coagulating, and the absorption of the muriate of soda is probably the cause of scurvy. Many morbid poisons, also, as that of typhus fever or of small-pox, also have a similar tendency. Hæmorrhage, therefore, may be caused by an altered state of the blood as well as by a diseased condition of the solids, and in many instances, perhaps, is referable to both causes. One of the most general laws of hæmorrhage, according to Gendrin, is, that when blood is effused into the substance of an organ, as the brain, it is never absorbed without the process of inflammation being set up.

Apoplexia

Is the effusion of blood within the cavity of the cranium, causing the patient suddenly to fall down, deprived on the instant of all sense and motion. This disease was well known in the Greek and Roman schools of medicine, and is of too frequent occurrence and of too striking a character to have escaped observation even in the rudest ages of society. In the year 1839, 5293 persons died of apoplexy, and 4910 of paralysis, probably in consequence of apoplexy, in England and Wales, thus giving one death in thirty-three from this cause in our own country.

Remote Cause.—Among the most frequent causes of apoplexy is an intemperate use of fermented liquors, a class of substances which not only powerfully excites and powerfully depresses the action of the brain, but also acts specifically on the heart and arteries, causing not only temporary energetic action of those parts, but also organic alterations in their structure. In the latter case the powers of the heart are often permanently augmented, while the coats of the arteries, thickened and thinned, or ulcerated, have their elasticity destroyed, and the tendency to hæmorrhage of the brain increased. The excessive use of narcotics, as opium or tobacco, is also supposed to predispose to congestion of the brain, and consequently to cerebral hæmorrhage. The bon-vivant, the indolent, and the sedentary person is the most frequent victim of this disease, from his usually plethoric habit.

Extremes of temperature, also, are powerful predis-

ponents to apoplexy; for in summer the fluids are expanded and the tone of the capillaries impaired, while in winter the cold drives the blood from the periphery of the body to its central organs, and consequently to the brain. Sudden and great vicissitudes of the weather, as they rapidly exhaust the nervous power, are more frequently fatal than the uniform continuance of its extremes, and these have been considered, on more than one occasion, as the cause of apoplexy prevailing to such an extent at Edinburgh and Rome as to be almost endemic.

The greater number of deaths from apoplexy in France, says Gendrin, during the last half century, has shown the powerful effects of *moral causes* in producing this fatal disorder. No times were ever more fruitful in conjunctions calculated to excite the passions and to rouse the moral feelings. Fortunes were broken, the bonds of relationship destroyed,—the cares of envy and of intrigue, the wounds of calumny, the dreams of ambition, the activity of political hatred, weighing still more heavily on the oppressor than on the oppressed, were all in their fullest activity, unchecked by any true principle of religion or of sound philosophy.

Mechanical obstruction is also a frequent occasion of apoplexy. If an obstacle, for example, be opposed to the course of the blood, as when the valves of the heart are diseased, the blood accumulates in the capillary system generally, and consequently in the brain. Apoplexy is still more common when the aorta is diseased, the force of the heart, unchecked by the elasticity of that vessel, acting directly on the brain, so that its vessels often give way from this cause. Mechanical violence, also, often produces apoplectic effusion. Thus a concussion of the brain always produces temporary congestion of that organ, while, if severe, effusion may take place behind the dura mater, or between the membranes, as well as into the substance of the brain, which may be extensively ruptured. A workman fell into a well, fractured both his legs, and died two hours afterwards. In this case a large apoplectic *foyer*, filled with blood, existed in the brain, which had so lacerated its substance that both the lateral ventricles communicated.

Predisposing Causes.—Apoplexy occurs even in some few instances in childhood. Billard gives the case of a child that died apoplectic at three days old from effusion into the left hemisphere and about the lateral parts of the corpora striata. Serres also saw a similar case in a child three months old. Apoplexy, however, is extremely rare till puberty, and only a few cases are met with before twenty. It is not unfrequent between thirty and fifty, while after fifty it is one of the most frequent causes of death. There are many circumstances which favour the occurrence of apoplexy in old age. At that period the capillary system becomes in part obliterated in all organs, and thus the veins are filled with a greater quantity of blood, or become congested. The cerebral arteries also are often diseased; the heart also has frequently acquired an abnormal power, driving the blood with great violence towards the brain, while the lungs have their functions impaired, so that the blood is only imperfectly oxygenated; and all these are causes of congestion and of tendency to rupture of the vessels of the brain.

Both sexes are liable to this affection, and in nearly equal proportion; the number of deaths in the male population of this country in 1839 being 2809, and of the female portion 2484. The party most liable to attack is florid in complexion, short in the neck, prominent in the eye, broad in the chest, protuberant in the belly, and loaded with fat, and sometimes enormously so. Many thin persons, with spare long necks, however, frequently fall from apoplexy, but it is probable in these cases that their heart, or large vessels, must be diseased. As form descends, a large number of apoplexies appear to be hereditary, and many successive generations fall from this complaint. It is common also in families.

The act of digestion appears to predispose to apoplexy, for numbers are attacked after dinner. Sleep, also, which many physiologists suppose to be caused by a temporary congestion of the vessels of the brain, is another predisposing circumstance. Thus of 176 cases examined by Gendrin, 97 had been attacked during sleep.

Many diseases also predispose to apoplexy, as mania, epilepsy, also suppressed hæmorrhoids, amenorrhœa, and especially the "turn of life," and probably from the plethora they induce.

Pathology.—Some very few cases have died from apoplexy when nothing has been found but congestion of the vessels of the scalp, of the membranes of the brain, and of the brain itself, but without the extravasation of a particle of blood, so that the party has fallen from mere pressure on the brain, caused by the apoplectic orgasm. The rule, however, in apoplexy, is, that a greater or less quantity of blood is effused either into the cavity of the arachnoid, or else into the substance of the brain, or into both in every case. When the quantity is trifling, the disease is seldom fatal on the first attack, so that in examining apoplectic cases it is not unusual to find a cavity scarcely bigger than an oat in the substance of the brain, the evidence of the primary attack, and containing perhaps a dry clot of blood. On the contrary, if the blood be effused among the membranes, it may be altogether absorbed, and not a trace of disease be found. In severe cases, still greater quantities of blood are effused, while, if the apoplexy be "foudroyante," and destroy the patient in a few minutes or a few hours, the quantity of blood effused will sometimes fill the whole cavity of the arachnoid, or extensively rupture the substance of the brain, forming a cavity as large as a nut or an egg, or even lay the ventricles one into the other.

It is rare that sanguineous effusion occupies both cerebral lobes, or the whole extent of the membranes of the brain, although such instances are occasionally seen. More commonly it is limited to the substance of one hemisphere, or to the membranes covering it. When the membranes of the brain are affected, the more immediate seat of the hæmorrhage is usually that portion covering the convexity of the brain. This varies, however; and the portion covering the base, or that investing the cerebellum, or indeed any other part, may be its seat.

The superficial membranes of the brain are not the only membranes of that organ which are the seat of apoplectic effusion, for hæmorrhage may take place from the membrane lining the ventricles, and which sometimes bleeds so profusely as not only to fill the lateral ventricles, but even to enlarge their cavities. As death in these severe cases is usually sudden, the walls of the ventricles are generally healthy, but in some very few instances the septum lucidum has been found ruptured, so that the ventricles have communicated. No case, however, is known of a simultaneous effusion into both lateral ventricles. The smaller ventricles are in a very

Elementary Principles of Medicine.

few instances also the seat of apoplectic effusion, Dr. Abercrombie having given a case in which the third and fourth ventricles were filled with blood. This patient was not at first insensible, but gradually became so, and died in a few hours.

The appearance of the blood effused into the membranes of the brain varies according to the time which elapses before the patient dies. If that event takes place in a few hours after the attack, the blood is still fluid, or else is found in black clots, while the membranes, except being infiltrated with blood, are as yet healthy. The substance of the brain, likewise, has no other appearance of disease than being flattened from the pressure of the extravasated blood. If the patient, however, survive a few days, the membranes show marks of inflammatory action, are injected, thickened, and although dry and pitchy in the immediate neighbourhood of the clot, have yet some serum effused in other parts of their cavity. The convolutions of the affected part of the brain are likewise now not only flattened, but softened (ramollie).

When effusion has taken place into the substance of the brain, if the patient has died in the fit, or shortly after, the hæmorrhagic *foyer* is found filled with half-coagulated blood, its walls irregularly softened, and dyed for some lines in thickness with the colouring matter of the blood; and a small stream of water thrown upon this part at once removes the extravasated blood, and also a layer of cerebral matter. Again, if the patient has survived a week, the blood is found coagulated, and the serum set free; but the presence of the clot has caused inflammation, so that the walls of the cavity are not only discoloured but softened, and are softer in proportion as they are nearer the clot. If life be prolonged till the fifteenth day, the serosity is absorbed, but the walls of the cavity are still of a deep red. About the thirtieth day, if the patient live so long, the clot is isolated, and a membrane forms, at first muciform, fragile, intermixed with particles of cerebral matter, and also with some of the colouring matter of the clot. By degrees, this membrane becomes more consistent, the clot diminishes, and some serum is probably secreted by the new membrane surrounding it. The cerebral walls surrounding the cyst, before softened, now become indurated, and are stained yellow from the usual changes which the extravasated blood with which they are penetrated undergoes, a colour however which they ultimately lose. The cavity thus formed is at length, perhaps, filled with nothing but serum, or, the serum being absorbed, the membranous cyst may ossify, and be thus converted into a bony tumor. At other times, the opposite sides of the cavity unite by a kind of cellular membrane, which thus forms a species of cicatrix, but possessing so little power of conducting nervous influence that the patient seldom recovers from his palsy. Such is a short outline of the effects of hæmorrhage into the substance of the brain. The size of an apoplectic *foyer*, it has been stated, varies from an oat to that of an egg, and their number is as variable as their extent. Sometimes we find but one, sometimes two, and in a very few instances three or more. When many *foyers* exist in the brain, it is rare to find them all in the same state, for some are old and almost obliterated, others are fresher, and others again quite recent, their different stages marking a distinct and different period of attack. As to the particular seats of the apoplectic effusion, Andral has collected a series of cases, and found the following to be the order of their frequency:—

Effusion into that part of the cerebral hemispheres situated on a level with the corpora striata and thalami opticorum, and at the same time into those two centres.	202
Effusion into the corpora striata .	61
Thalami opticorum	35
Portions of the hemispheres situated above the centum ovale . . .	27
Lateral lobes of the cerebellum .	16
Before the corpora striata . . .	10
Mesocephalus	9
Spinal cord	8
Behind thalami opticorum, or in the posterior lobes	7
Median lobe of cerebellum . . .	5
Peduncle of the brain	3
Peduncle of the cerebellum . .	1
Corpora olivaria	1
Pituitary gland	1
	386

Many pathologists affirm that apoplexy is caused by rupture of the blood-vessels in every case, although they admit this state of parts can rarely be demonstrated, the ruptured vessels being generally less than one-third of a line in diameter, and consequently too small to be manifest to sense. That rupture of vessels is occasionally the cause of cerebral hæmorrhage there can be no doubt, for Rochoux, Abercrombie, and others, have collected instances of the rupture of the larger superficial vessels of the brain, as of the carotid, the basiliary, and of the meningeal arteries, these vessels being either aneurismal, ossified, cartilaginous, or otherwise previously diseased; but even these cases are very rare.

It is certain also that the large encephalic veins are in a very small number of instances found ruptured in apoplexy, as the venous sinuses. As a general rule, however, apoplexy is the result of an hæmorrhagic action or exudation from the coats or mouths of the capillary vessels.

It has been a favourite object with pathologists to connect the lesions of the brain, found after death, with the symptoms during life. But apoplexy has not furnished us with any analysis of the organs of the mind. It has, however, determined one general law with respect to motion, or that the power of volition is crossed, each hemisphere commanding the motions of the limbs of the opposite side. The theory of apoplexy is of considerable difficulty; the quantity of blood effused is often so small that it is impossible to account for the symptoms from mere pressure. It is probable, therefore, that the blood effused is a consequence of an apoplectic orgasm residing in the brain itself. The subsequent palsy of course depends on pressure or other injury done to the brain.

Symptoms.—Encephalic hæmorrhage may take place suddenly, and while the patient is in his best health. More commonly, perhaps, it is preceded for a few hours or a few days by giddiness, by fulness, weight, or severe pain of the head; by deafness, noise in the ears, or by violent palpitation of the heart. In other cases the mind is affected, and the memory or other faculty sensibly impaired; or the patient has a feeling of numb-

ness in his fingers, or is deluded by optical illusions. At length the *fit* of apoplexy takes place, and in one of three degrees of intensity, termed by Rostan *apoplexie faible*, *apoplexie moyenne*, and *apoplexie forte*.

The distinguishing symptom of these different degrees is the mode in which the fit terminates. In the first degree, the patient recovers with the entire use both of his limbs and of his mental faculties. In the second degree, if he is restored, one or more of his limbs are palsied, and his mind more or less impaired; while, in the third degree, he dies in the fit, seldom giving any sign of sense, of motion, or of intelligence.

The symptoms of the first degree, or *coup de sang, ou apoplexie faible, ou fugace*, are that the patient, on the instant of his seizure, suddenly becomes insensible, and if standing, he falls to the ground; or, if sitting, he makes perhaps a convulsive effort to rise; or else his head falls on his chest, as in a deep sleep, but his face is pale or purple, his mouth often drawn, and his eye fixed, with the pupil insensible to light. In whatever position, however, he may be seized, his limbs, when raised, fall by their own gravity; his pulse, though not greatly accelerated, is full, and the carotids are in strong action. His respiration is slow and deep, and the temperature of the head and neck is increased, but that of the extremities diminished.

The duration of the fit in this mild form of the disease is very various, sometimes lasting only a few minutes, and seldom exceeding two or three hours. The first symptoms of recovery are, the nose becoming sensible to irritants, the eye to light, and then succeed a few convulsive movements, a few deep-drawn sighs, and the patient is restored to consciousness; he has, however, no recollection of what has passed; his looks express astonishment, his tongue is swollen, and his replies slow; he remains enfeebled in body and in mind for a few days, but at length recovers, nevertheless often bearing about him, and for a long time, marks of the shock his brain has sustained.

It is rare that the *coup de sang* is not renewed, for more generally it is only the commencement of a series of attacks which ultimately destroy the patient. Popular opinion supposes the patient to suffer three apoplectic attacks, the first being mild, the second followed by paralysis, while the third is fatal. It is only in a few instances that this number is exceeded.

In the second degree of apoplexy, or *apoplexie moyenne, ou paraplexie*, the symptoms of the fit are similar, only more severe and last longer, or perhaps from two to twelve or fourteen hours, and on the patient recovering it is found that many important functions depending on the brain are profoundly and permanently impaired. These lesions are most usually hemiplegia, or palsy of one side of the body, and perhaps of one side of the face or of the tongue. In other cases, however, only one limb, or part of a limb, is affected, as an arm, the fore arm, or a hand; while in others it is only one leg, which, if the attack be mild, the patient is able to move in bed, but if he attempts to walk, it drags, or else, it being too feeble to support the weight of his body, he falls down. In other rare instances the paralysis is crossed, the arm of one side and the leg of the other being affected; or the patient is paralyzed, both arms or both extremities being palsied.

In some cases only one set of muscles is palsied, generally the extensors, so that the leg may be forcibly bent against the buttock, or the fore arm flexed upon the upper arm. Sometimes, however, the extensors are alone affected, so that the knees may be drawn up to the chin.

If the patient survives any length of time he usually recovers some use of his leg, so that he is able to walk with a "straight leg" and a dragging foot; but the use of his arm returns more slowly and more imperfectly. This recovery is often preceded and accompanied by very severe pains, especially of the upper extremity, marking the still irritated state of the brain. The limb, however, uniformly wastes, and its vital powers are so impaired that if inflamed the inflammation seldom terminates by resolution, but has a great tendency to gangrene, while cicatrization is slow and difficult.

The abolition of sensation is complete during the fit, but in general the patient entirely recovers all his senses. In some cases, however, he is affected not only with palsy, but also with anæsthesia, so that you may prick, pinch, or burn the affected limb without giving any pain. In other cases, again, the patient is palsied on one side, and deprived of all sensation on the other; in others the anæsthesia exists without the palsy. In a patient lately in St. Thomas's Hospital, the right arm, without being palsied, was so numbed or affected with anæsthesia after apoplexy, that the party was unconscious of what he held in that hand, and consequently when not looking at it let everything fall. One side of his face was also in a similar state of insensibility. In general the patient recovers the sensations of the part before he acquires the power of moving it, but in other cases the event is reversed, and he recovers the use of the limb although it remains permanently in a state of anæsthesia.

The apoplectic patient in some rare cases labours under amaurosis, or else objects appear to him black and without any determinate form, or he sees only one-half of an object, or else one-half appears of one colour and the other half of a different colour. Deafness is very unusual after apoplexy, but the loss of the senses of smell and of taste are very common.

It is singular that parts struck with anæsthesia do not waste as in palsy, neither are they exempted from the action of many morbid poisons. A patient, for instance, was seized with small-pox while labouring under anæsthesia of the arm, when the diseased limb was equally affected with the sound one. Another affected by anæsthesia of the face, was seized with erysipelas of the face, when he presented the curious fact of suffering much pain on the sound side, but was entirely free from pain on the affected side.

The patient, on recovering from the attack, has sometimes the good fortune to recover all the faculties of his mind, but more commonly his memory is impaired often to such a degree that he has forgotten all dates, the names of his friends, or even the names of things. Broussonet, professor of medicine at Montpellier, had entirely lost the remembrance of all noun substantives; and another case is given in which the patient lost all his adjectives. In some instances the power of association is also so destroyed that although many remember both names and things, they are unable to connect the thing with the proper word, so that they call that which is cold, hot; or speak of night when they mean day; or call a coffee-pot a wash-hand basin. Others, again, have forgotten how to read, and the power thus lost either returns suddenly, or else they are obliged to learn *de novo*.

The attention is also very greatly impaired, and the patient is no longer able to transact business; or if he begins a sentence is unable to finish it, or he repeats the same idea over and over again. The passions also are little under control, for some weep like children; others laugh immoderately, and all are easily terrified, or otherwise easily acted upon.

Nothing is more variable than the time of recovery after a paralytic attack. In a very few instances the patient is restored in a few days, or in a few weeks, or in a few months, but more commonly the lesions of motion as well as of the mind are permanent, or nearly so. In general, however, some slight improvement takes place even in the worst cases, so that the patient recovers some use first of his leg, and then, perhaps, of his arm.

The adverse circumstances attending recovery from apoplexy are, that although the patient appears to be doing well the first few days after the attack, yet towards the close of the first week the brain, irritated by the presence of the clot, inflames and softens, and thus induces another and a fatal attack of apoplexy. Should the patient, however, survive this dangerous period, he may continue to live many months, or years, according to his age; but he is generally at length cut off by a fresh attack of apoplexy, or else his brain ultimately inflames and softens, and he dies in a typhoid state.

The third degree of apoplexy, or *apoplexie forte*, or *foudroyante*, is that in which the patient lies almost without sense or motion, his face purple and swollen, his eye half open, his respiration stertorous, and his extremities cold, although his pulse is often natural. From this state nothing rouses him, or only to some ejaculation indicating uneasiness. The symptoms which have been mentioned show that the eighth pair and the phrenic nerves are affected, and this is generally followed by the symptoms termed "*fumée la pipe*," denoting palsy of the seventh pair, and in this state the patient dies sometimes in a few minutes, and rarely survives more than a few hours.

Diagnosis.—Apoplexy is distinguished from epilepsy by the absence both of convulsions and of foaming at the mouth; and from *ramollissement* of the brain by the suddenness of the attack.

Prognosis.—Apoplexy is always a grave disease, and the more grave in proportion as the respiration is stertorous and the deglutition difficult. When the symptom termed *fumée la pipe* is present recovery is nearly hopeless. Each succeeding attack is more dangerous than the former. The practitioner should be guarded in his prognosis till after the first week or ten days, lest inflammation should come on, or a fresh attack destroy the patient.

Treatment.—The patient, if seen during the fit, should be bled, and bled copiously, in order to relieve the congestion, and also to check, if possible, a further effusion of blood. The quantity taken should be proportioned to the degree of stertor and to the powers of the patient; and sixteen, twenty, and even thirty ounces may be allowed to flow. If the latter quantity is not followed by some degree of consciousness, it may be inferred that the amount of blood effused is considerable, and that the patient in all probability will not recover. Still, perhaps, an additional chance will be given by applying cold to the head, leeches to the temples, and mustard cataplasms to the feet, also by placing a drop or two of croton oil on the tongue, and by throwing up a cathartic enema of castor oil or other medicament, but not one of turpentine, as is commonly done, for the intoxication that produces must be decidedly injurious.

Some persons are disinclined to any considerable bleeding during the fit, considering that the bony structure which contains the brain removes all atmospheric pressure so entirely as to cause that organ at all times to contain an equal quantity of blood. The brain, however, is not a mechanical syphon, but a living machine governed by vital laws; has a space for a very sensible expansion and contraction at each pulsation of the heart, while posthumous examination shows it to contain very different quantities of blood, it being sometimes gorged, and sometimes blanched of blood. These facts distinctly show that it must possess the power of regulating the quantity of blood sent to it; and we ought therefore in a disease of this moment to follow the dictates of a long experience rather than the conclusions of a fallacious reasoning.

After the patient has in some degree revived, and the congestion consequently removed, we may pause for a few hours and allow some time for the absorption of the blood effused; for any very large depletion after that point is gained would rather facilitate extravasation than prevent it. A few hours then having elapsed, the conduct of the practitioner should be guided by the *pain of the head*, which may be taken as a measure of the fulness of the brain, and its tendency to inflammation. If, therefore, there be pain in the head, ten to twelve leeches should be applied from time to time till that symptom is entirely relieved; or, supposing the pulse to be full and strong, and the patient free from headache, yet under these circumstances leeches should be applied to the head to anticipate that re-action which so generally takes place from the fourth to the seventh day.

The further treatment of the case is by moderately purging the patient, both as a means of relieving the head, as also of improving the secretions of the alimentary canal, which are often black and fœtid; and five grains of calomel given as soon as the patient can swallow, and followed up by a black draught, or by sulphate of magnesia ʒj. out of camphor mixture every four or six hours, and continued according to its effects for a greater or less length of time, are, perhaps, the best means we have for promoting the recovery of the patient, and for preventing a relapse. The foregoing prescriptions are recommended on the supposition that the attack has been caused by simple plethora. In many cases, however, it is a consequence of hypertrophy of the heart; and in such cases less blood should be taken, and eight to ten minims of digitalis be added to each dose of the purgative medicine, or the pulv. seminarum iberidis, grs. iij. to v. ter die should be substituted.

All apprehension of a relapse being at an end, the patient is in general most willing to believe that the palsy is a mere local disease, and to submit to any treatment for its removal. The ancients applied actual cautery to the extremities, to the coronal suture, or to the occiput, but without, as it is understood, any beneficial success. The moderns have had recourse to blisters, to friction, to electricity, and to strychnine; but every attempt to act locally on the muscular system may be stated to have failed. In those few cases which are capable of being relieved, and they are but few, the secale cornutum grs. x. ter die has appeared the most efficient remedy.

Dietetic Treatment.—The diet of the patient should, till all apprehension of a relapse is passed, be low, and

limited to milk, boiled vegetables, light puddings, and fish; and at no subsequent period ought he to indulge in a full animal diet, or to drink undiluted wines.

Of Epistaxis.

Epistaxis is a hæmorrhage from the mucous membrane of the nose.

Remote Cause.—Everybody knows that a blow, exposure to a high temperature, crying, or any violent muscular exertion, may be a cause of epistaxis. In some cases it is occasioned by worms, while in others it is constitutional. Some morbid poisons also give rise to it, as that of scurvy, fever, and small-pox.

Predisposing Causes.—This disease occasionally occurs in children of three or four years old. Gendrin mentions a family of three children who suffered every five or six days from epistaxis, from the age of eight to fifteen years old. More commonly it attacks adults between fifteen and twenty-five; no age is entirely exempt from it. Women are equally if not more predisposed to this disease than men, and especially when suffering from amenorrhœa. Hoffman conceives epistaxis to be often hereditary, and has seen it run in families.

Pathology.—Epistaxis in an immense majority of cases is merely the result of an hæmorrhagic action from the nasal membrane without any breach of surface. Indeed, if the hæmorrhage, as is often the case, proceeds from a point low down in the nostrils, the blood is seen to exude from the surface of the sound mucous membrane, only slightly injected.

Symptoms.—The attack of epistaxis may be sudden, or it may be preceded by weight or pain in the head; by heat, redness, or itching of the nostril. As soon as the hæmorrhage is established, the blood issues forth generally in drops, and only rarely in a continued stream, and very seldom from both nostrils. The blood effused at length coagulates; and if on the part from which the hæmorrhage proceeds, the flow of blood ceases; if not, it continues to flow externally, or if internally, down the pharynx.

The quantity of blood lost is very various, sometimes only a few drops, more commonly half an ounce to two ounces; while in other cases it may amount to some pounds. The duration of epistaxis is ordinarily short, often only a few seconds or a few minutes, but in a very few cases it lasts from one to two hours, and has been known to last twenty-four hours. In these latter cases the patient is greatly exhausted, blanched, and leucophlegmatic, his legs swell, and his appearance is perfectly chlorotic.

Diagnosis.—The only difficulty in the diagnosis of epistaxis is when the blood escapes posteriorly by the pharynx instead of anteriorly and by the nostrils.

Prognosis.—Nasal hæmorrhage is rarely dangerous; in a few instances, however, it is so copious that the patient is greatly exhausted; still, in general, so far from being dangerous it is favourable to health by dissipating headache, and a tendency to cerebral congestion. It has been observed that persons subject to epistaxis when children, easily contract grave diseases of the chest, as hæmoptysis, pleurisy, peripnuemonia, and even phthisis in youth; while in more advanced age they become subject to hæmorrhoids, rheumatism, or gout.

Treatment.—Slight cases of epistaxis require no treatment, and hardly any attention. In severer cases cold water, applied by a sponge to the nose, putting the hands in a basin of cold water, and perhaps putting the key of the street door down the back is sufficient to arrest it in a few minutes. If the bleeding should continue after these means have been tried, Valsain found that the hæmorrhage often proceeded from a point so near the extremity of the nostril that it could be compressed by the finger; and he mentions having cured in this manner a case of epistaxis which had burst forth every year for four years. If the seat of the hæmorrhage is beyond the reach of the finger, a pledget dipped in some styptic, as a solution of alum, or of the sulphate of zinc, or sulphate of iron, should be passed up the nose. If the hæmorrhage is very great, and the above methods unsuccessful, it is necessary to plug the nose. This is effected by passing up the nostril a bougie to which a double thread is attached; by means of the one a pledget is to be drawn through the mouth into the posterior nostrils, while another pledget is to be drawn up through the nostril. In this manner the anterior and posterior nostrils are equally blocked up, and the blood, unable to escape, coagulates, and the hæmorrhage is stopped. This operation, trifling as it is, always causes headache, and is painful to the patient. The pledgets should be allowed to remain two or three days and then withdrawn, the coagula now beginning to undergo decomposition, and to become offensive. In cases where the tendency to nasal hæmorrhage is great, the mineral acids, as the inf. rosæ c. acidi sulph. dilut. ♏ iij. to ♏ v. should be exhibited, or, perhaps, what is still better, the bitartrate of potash, ʒ ſs. to ʒ j. bis die, and the general health of the patient should likewise be attended to and restored.

The patient's diet should be light, and the quantity of animal food be either diminished, or for a time be abstained from altogether; light French wines should be preferred to port or sherry, and he should avoid any severe study or exercise.

Hæmoptysis, or bronchial Hæmorrhage.

Hæmoptysis is an hæmorrhage from the lungs.

Remote Causes.—Hæmoptysis may proceed from heat or cold, or sudden transitions of temperature, or else from variations of atmospheric pressure, as from ascending a high mountain, or descending in the diving-bell. It may result also from over-exertion, from plethora, from mechanical violence, and from a violent and disturbed state of the passions.

More commonly hæmoptysis is symptomatic, and results from amenorrhœa, from diseased heart, and more especially from phthisis. Pneumonia is also very constantly attended by hæmoptysis, and consequently every morbid poison which produces inflammation of the lung is a cause of hæmoptysis, as the poison of small-pox, of hooping-cough, of the paludal poison, and also of scurvy.

Predisposing Causes.—Schmidtman, in a practice of thirty years, has seen hæmoptysis seven times in infants. Gendrin once saw it in a child eight years old. More generally, however, it is a disease incident to adolescence, and to the earlier part of riper age. Borrieri limits it between twenty-two and thirty-five; but Frank, with more propriety, extends it from sixteen to thirty-six; but it occurs in cases of diseased heart, and also in phthisis at still later periods. The hereditary tendency to hæmoptysis is as incontestible as to that of phthisis.

Pathology.—When the patient falls after an attack of idiopathic hæmoptysis, the bronchial tubes of the affected lung are found more or less filled with fluid or coagulated blood; but in ninety-nine cases out of a hundred the minutest examination is unable to discover

the slightest structural lesion, except perhaps some slight congestion of the bronchial mucous membrane. It seems proved, therefore, that hæmoptysis is caused, in the vast majority of cases, by an hæmorrhagic action of the bronchial membrane, and only in a very few rare instances by rupture of a blood-vessel. Even when the hæmoptysis follows the deposition of tubercular matter which has terminated in abscess, still the hemorrhage, with some very rare exceptions, always comes from the bronchial membrane, the tubercular deposit constantly turning the blood-vessels aside, or else obliterating them, so that perhaps not in one case in five hundred does a blood-vessel traverse the abscess, or is in any way exposed to ulceration or to rupture. It is rare that the hæmoptysis takes place from both lungs. The particular seat of hæmoptysis is *supposed* to be the larger bronchi; for if excessive hemorrhage should take place from the smaller bronchi, it is apprehended the patient must die suffocated. Many other diseases besides phthisis, and especially disease of the heart, are found to co-exist with hæmoptysis.

Symptoms.—Hæmoptysis may take place suddenly, or be preceded by a sense of heat or a feeling of weight at the chest, or the patient may suffer pain between the back and shoulders, or may labour under dyspnœa, palpitation, cough, or coldness of the extremities, and these symptoms may last two or three days. At length the party is seized with a fit of coughing, or a tickling of the throat, and then vomits up sometimes arterial but more often venous blood. The quantity is very various, sometimes not more than streaks the sputa, at others a few ounces, or else some pounds, terrifying both the patient and the bystanders by its vast amount. Laënnec says he has seen as much as ten pints thrown up in forty-eight hours, and as much as thirty pints in a fortnight. The effort of coughing also often causes vomiting, so that the blood discharged is frequently mixed with alimentary matters.

If the quantity thrown up be inconsiderable, the patient's previous health is in no degree affected; but if it be large its effects are strongly marked, for the patient feels oppressed at the præcordia, breathes with difficulty, and with a gurgling sound, caused by the air passing through the viscid blood retained in the bronchi; and this is shortly followed by increasing weakness, even to complete prostration. In still severer cases, as the blood flows the patient turns pale, his countenance becomes œdematous and strongly expressive of terror, or else he falls into a complete syncope. In a very few instances the effusion is so sudden and so considerable that the patient dies suffocated.

It is customary for bronchial hæmorrhage, when considerable, to diminish rapidly, so that at the end of some hours only a few rare isolated sputa are spat up, and at considerable intervals. Usually, however, the hæmoptysis recurs after a greater or less length of time, but not perhaps to the extent of the primary attack.

After the patient has lain for a greater or less length of time in this state of depression a re-action takes place. In sthenic persons the appetite becomes increased, they enjoy everything they are allowed to eat, and after some slight febrile action they rapidly recover. In the fatal cases the pulse becomes rapid, the tongue brown and dry, and the patient sinks with every typhoid symptom. In hæmoptysis the resonance of the chest is in general natural, while the stethescopic sounds vary according to the amount of blood retained in the bronchi. In many cases no abnormal sound exists, in others there is some slight mucous rhonchus, which perhaps ultimately becomes tracheal, and denotes the extreme danger in which the patient lies.

Diagnosis.—The only disease which it is important to distinguish from hæmoptysis is hæmatemesis, and the diagnosis between them is difficult, as the contents of the stomach are often rejected in both cases. The stethescope, however, greatly assists in determining the seat of the disease; and, again, blood is generally found in the stools in cases of hæmatemesis, while it is for the most part wanting in hæmoptysis.

Prognosis.—Idiopathic hæmoptysis, the lung being healthy, unless the quantity of blood lost is very considerable, is seldom dangerous. When, however, the heart, the lung, or the spleen is extensively diseased the prognosis is always unfavourable, and in proportion to the amount of blood lost.

Treatment.—In idiopathic hæmoptysis, the lung and other viscera being sound, it is seldom necessary to bleed the patient, for if the quantity of blood thrown up be large that operation is often dangerous, and if small unnecessary. There are a small number of cases, however, in which bleeding may be necessary, as when the pulse suddenly becomes small and frequent without the powers of the patient being greatly depressed, for this symptom is the forerunner of a renewal of the hæmorrhagic orgasm. The medicines most useful in this form of hæmoptysis are the bitartrate of potash ʒj. 6^{tis} vel 4^{tis} horis, and to each dose of which may be added a quarter to half a grain of opium. Other practitioners prefer the mineral acids, as the infusi rosæ c. acid. sulph. dilut. ♏iij. to ♏x. c. tinct. opii ♏iij. to ♏v. 4^{tis} vel 6^{tis}; larger doses of the dilute sulphuric acid have often been tried, but have constantly failed, being either rejected or else acting injuriously on the coats of the stomach. Many practitioners use plumbi acetati, gr. j. to gr. iij. 6^{tis} vel 4^{tis} horis, with half a grain of opium to each dose; and, according to Andral, when the system has long been under the influence of lead, the red globules suffer a great diminution; but, nevertheless, this is certainly a less efficacious medicine than either of the preceding ones. The nitrate of potash has been much used in France, but Gendrin has not found it efficient, or not more so than any other diuretic. The secale cornutum does not appear to possess any power over this disease. The muriate of soda in ʒſs. to ʒj. doses is in estimation with some practitioners on the continent.

When hæmoptysis is connected with amenorrhœa, preparations of iron often succeed when the above remedies have failed. Two grains of the sulphate of iron out of infusi rosæ, with ʒj. to ʒſs. of the sulphate of magnesia ter die, often restores the menstrual secretion, and cures the hæmoptysis. Indeed it is in this form of amenorrhœa that iron is most successful.

When hæmoptysis depends on disease of the heart, cupping from the chest or moderate bleeding from the arm is often efficacious, and always admissible. The medicines should now be the bitartrate of potash or the mineral acids, to which should be added ♏v. to ♏x. of the tinct. digitalis; it is in many cases proper to add ʒſs. to ʒj. of the sp. ætheris nitrici to each dose, to give tone and steadiness to the otherwise rolling action of the heart.

When hæmoptysis is produced by the presence of tubercles in the lungs the case is nearly hopeless. Bleeding only the more surely destroys the patient, and the

mineral or vegetable acids, as they have no power to heal the lung, so they are merely palliatives. They are, however, the best we possess, and therefore should be exhibited, combined perhaps with an opiate.

When the hæmoptysis results from a disease of the spleen, the patient is often supported through a first attack by wine and acids, but the hæmoptysis returns and usually destroys the patient.

When hæmoptysis is connected with inflammation, either from a specific or other poison, the treatment will be pointed out under the particular head of such disease.

Dietetic and general Treatment.—The patient should be placed in bed, with his head and shoulders raised; the window should be partly open so as to keep the room cool. Dr. Drake recommends that the air respired should pass through a tube containing ice; but as this experiment does not seem practicable, it is more common to place a bowl of ice immediately before the patient's mouth. Some practitioners have recommended ice to the chest; but this often causes great anxiety and constriction of the chest, and is of doubtful efficacy.

The bed-clothes should be light. The diet should be slops, and these slops cold, and if cooled to a low temperature by ice so much the better.

Pulmonary Apoplexy

Is an effusion of blood into the cellular substance of the lungs.

Latour appears to have been the first to describe this disease, in his *Hist. Philosop. et Med. des Hæmorrhagies*, t. i. et ii., p. 220. Orleans, 1815; and he gave it the name of *apoplexie pulmonaire*, and the term has been adopted by Laënnec.

Remote Cause.—Pulmonary apoplexy probably results from all those causes to which pathologists have attributed hæmoptysis. The worst cases, however, are generally seen to be connected with extensive disease of the heart. Morton mentions a singular case, in which a nail had made its way in a fit of laughter into the trachea, and produced pulmonary apoplexy. In a recent case at St. Thomas's Hospital, a patient that had scurvy died of pulmonary apoplexy.

Predisposing Causes.—This disease is rare, and has hitherto been observed only in adults.

Pathology.—In pulmonary apoplexy, when the effusion is trifling and the patient survives for some time, an induration at one or more points of the lung, and exactly circumscribed, is found, caused by an incorporation of the infiltrated blood with the tissue of the lung. These indurations may be black, brown, or red, and if scraped with the scalpel a half coagulated blood escapes, while the surrounding tissues are healthy, or only more or less congested. If the patient perfectly recover, either no trace of disease is found, or else the effused blood is absorbed, and the seat of apoplectic effusion, according to Laënnec, is marked only by a linear cicatrix, denoting an antecedent rupture of the cells of the lung. In graver cases, and when life is quickly extinguished, the blood effused into the lung is in considerable quantity, half coagulated, and the pulmonary tissue so broken down that it is impossible to demonstrate its structure, or to assign the limits of the *foyer*. In the worst cases the lung ruptures, and the effused blood escapes into the cavity of the chest. The bronchi, in most cases, also, are more or less loaded with blood.

Symptoms.—The symptoms of pulmonary apoplexy have various degrees, or the effusion may be slight and the patient recover, or it may be extensive and the patient survive some days, or it may be so sudden and considerable as to cause the immediate death of the patient.

The *first degree* of pulmonary apoplexy, it is supposed, can be determined during life; and if so the symptoms must be a sudden difficulty of breathing, some expectoration of blood, some mucous rhonchus, and a total inability for a time to lie down. On percussion of the chest, also, that portion which corresponds to the seat of the disease must return a dull sound. Gendrin is of opinion that blood cannot be effused without causing inflammation; and he conceives, if the patient recovers, pneumonia of little intensity always follows.

In pulmonary apoplexy of the *second degree*, the symptoms which have been described exist, but in a greater degree, so that the patient is more oppressed in his breathing; he is obliged to be supported by pillows, and his head often falls forward, while his face is purple, and his pulse small and frequent; yet, however formidable these symptoms are, life is still capable of co-existing with them for some time. Professor Mahon, of the Faculty of Medicine at Paris, only sunk after some days from apoplexy of the lung, and which had caused rupture, with effusion of blood, into the cavity of the chest. Another case, a woman, is supposed to have lived twelve days after the attack, and on her death the extravasated blood occupied more than one-half the left lung. In a case of excessively enlarged heart, with permanent patency of the aortic valves, the patient survived several days an effusion of blood into both lungs so considerable that they were almost disorganized.

In the *third degree* of pulmonary apoplexy the patient appears to be almost instantaneously destroyed. Dr. Fortussin, a person of strong health, but subject to hæmorrhoids, had suffered from cough with oppressed breathing. After supping off some grapes he went to bed at about half-past eleven, in a chamber next to that in which a patient lay whom Boyer had cut for the stone and confided to his care; at three in the morning the nurse went into the room and found him dead; he lay on his stomach, his left hand on his chest, and his right hand hanging out of bed; while around the bed was much blood that he had thrown up both by the mouth and nose. The body presented a violet tinge from the forehead to below the chest. He had died of apoplexy of the right lung, so considerable that its substance was ruptured in many places, and the right side of the chest filled with blood.

Diagnosis.—Apoplexy of the lung is distinguished from hæmoptysis by the dulness on percussion, by the "souffle tubaire," and by the subsequent fever and pnuemonia.

Prognosis.—Pulmonary apoplexy is always of grave prognosis; but should the patient survive the attack for a few days, and the effusion be inconsiderable and the subsequent inflammation slight, he may recover.

Treatment.—The treatment must of course depend on the disease being primary or symptomatic. When the apoplexy is primary, and the diagnosis can be relied on, bleeding, and perhaps to a considerable extent, together with the mineral acids or super-acid salts, appear to offer the most chances of recovery. If, on the contrary, the apoplexy be secondary, and depends on disease of the heart, the bleeding should be moderate, lest the heart be excited to a still more powerful action, and

Elementary Principles of Medicine.

in this case digitalis, and perhaps some slight narcotic, should be added, to tranquillize that too highly-excited organ.

The *dietetic* and *general treatment* are the same as have been directed for hæmoptysis.

Hæmatemesis—Gastrohæmorrhage—

Is a discharge of blood from the stomach.

Remote Cause.—Hæmatemesis may result from all those causes which have been mentioned as producing hæmoptysis, but it may arise also from causes which are peculiar to the stomach, as from the effect of vomiting, or from a blow. Another peculiar cause is ulceration of the gastric artery or vein, vessels which sometimes rupture from the effects of cancer or inflammation. Frank speaks of a girl who suffered from hæmatemesis, in consequence of a small bone sticking in the coats of the stomach. In armies on actual service the thirsty soldier sometimes suffers from this affection, in consequence of drinking incautiously water containing leeches.

Predisposing Causes.—New-born children are sometimes subject to this disease from the day of birth till about twelve days old. Gendrin gives three cases of this kind, although there was nothing unusual in the delivery. Except at this early period hæmatemesis is rare till puberty. Frank, indeed, says he never saw this disease before puberty, nor after sixty. Both sexes are equally liable to it; but women suffer more frequently than men, and especially those who are either pregnant or labour under amenorrhœa.

Pathology.—On opening the stomach of a patient that has died of hæmatemesis blood is found in various degrees of consistency, or from a pure liquid black or brown blood to a solid coagulum. Portions of the blood thus extravasated are also found in the œsophagus and in the intestines. The internal surface of the stomach is almost always coated with a layer of viscid mucus which separates it from the clot. This mucus is necessarily dyed of a red colour. The quantity of blood found is very various. Dr. Elliotson saw a patient fall back and die in a minute or two with blood rushing from his mouth. On opening his stomach that organ was found distended with blood to the utmost, forming a perfect mould of the cavity. In general, the mucous membrane of the stomach is hardly stained with the colouring matter of the blood, but it is congested, and in some few spots ecchymosed—blood being infiltrated into the sub-cellular tissue. On the contrary, the surface of the mucous membrane of the intestines is almost always stained at the depending parts.

The stomach, though generally healthy, is sometimes found diseased, and the hæmatemesis is a consequence of ulceration of an artery or vein. Latour speaks of a girl who died suddenly after some fruitless attempts to vomit, and whose stomach was filled with blood, in consequence of an ulceration which had involved several vessels of the stomach. Cruveilhier gives a similar instance of ulceration of the coronary arteries; and Goëppert of ulceration of the coronary veins of the stomach. The most frequent cause of ulceration of the blood-vessels of the stomach, however, is cancer.

When hæmatemesis is symptomatic the disease found is extremely various. In one case it resulted from a schirrous tumor of the pancreas; in another from an enlarged kidney compressing the aorta; in a third from an aneurism of the cœliac artery, which, obstructing the hepatic and splenic arteries, had caused the greater portion of the blood conveyed by those arteries to pass through the gastric artery, and thus caused congestion of the mucous membrane of the stomach. Frank found in the stomach of a woman, who died of hæmatemesis at Pavia, a clot which weighed five pounds; there was no lesion of the stomach, but the liver was tuberculated and in a state of suppuration. Morgagni gives a case of hæmatemesis, in which the spleen was bigger than the liver, and weighed four pounds and a half, and Barry has given a similar case. Sometimes in symptomatic hæmatemesis the blood thrown up has come from an aneurism of the aorta bursting into the stomach; and Lieutaud gives an instance in which the blood came directly from the liver, which had adhered to the ruptured stomach.

Symptoms.—Hæmatemesis may be acute or chronic, the chronic form being usually termed melæna.

The acute form of hæmatemesis may be sudden in its attack, or may be preceded for a few hours by shivering, heat, weight and oppression at the epigastrium, by nausea, headache, and by pains between the shoulders. The buccal and pharyngeal membranes are also said to be sometimes congested, and the gums swollen. Gendrin likewise esteems a swollen state of the liver or spleen one of the primary symptoms, having observed those phenomena in five or six cases.

At length the hæmatemesis occurs, and a quantity of blood, black, clotted, and mixed with alimentary matters, is thrown up, sometimes streaming both from the nose and mouth. The symptoms which now follow are proportioned to the quantity of blood lost, and are nearly the same as in hæmoptysis. If the quantity be small, the pain in the epigastrium ceases, and the patient is relieved. If larger, the patient is in some degree relieved, but greatly exhausted; while, if the quantity thrown up, as it often is, be so abundant as to half fill a wash-hand basin or a chamber vessel, the patient becomes pale, a cold perspiration runs down his face, he has an overwhelming sense of sinking, and his pulse becomes frequent and weak. There are even instances in which hæmatemesis has proved suddenly fatal; for Frank relates the case of a man, aged sixty, who died suddenly and without any manifest cause, and whose stomach was found filled with an enormous quantity of blood.

It is rare that the attack terminates by one vomiting of blood. In the greater number of cases a few hours have scarcely elapsed than the epigastric and dorsal pains are renewed, the thirst and shivering return, and the vomiting recurs, often perhaps four or five times in the space of two or three days; a sensation, as of a burning liquid in the stomach, often precedes these subsequent attacks.

The symptoms which mark the recovery or else the death of the patient are the same as those which occur in hæmoptysis.

The bowels, which are ordinarily constipated previously to the hæmorrhage, generally become spontaneously open shortly after its occurrence. The stools are at first natural, but quickly become black, semi-liquid, very fœtid, and evidently contain blood mixed with bile and fæces. The abdomen is often meteorised, and the seat of painful colic.

It is supposed that hæmorrhage from the stomach may take place without vomiting, the blood passing into the duodenum, and being ejected by the intestines.

The *colour* of the blood thrown up varies according to the time it has sojourned in the stomach. If poured

out rapidly and immediately rejected it is often arterial, but accumulated slowly it is of a blackish brown, and clotted. Sometimes a thin layer of coagulated blood forms, which when thrown up has been mistaken for a portion of the mucous membrane of the stomach.

The chronic form of hæmatemesis is termed *gastro-melæna*. In this form of the disease the blood is not poured out pure, but undergoes some change in the capillary system, so that it resembles chocolate or coffee grounds, and is, in fact, a species of black vomit. This affection usually occurs as the last stage of many diseases, especially if the patient be of a broken and worn-out constitution. The quantity thrown up is often large, amounting to a pint or two in the course of the day, and this may last for several days. When the patient falls, which is usually the case, the stomach is found congested, but without other appreciable lesion. Dr. Baillie mentions having met with a few of these cases with no very urgent symptoms, and which ultimately recovered. In this form of hæmatemesis, also, the melænic matters often pass in the stools.

Diagnosis.—The chief difficulty in the diagnosis of hæmatemesis is to distinguish it from hæmoptysis; but the burning heat of the stomach, the black pitchy stools, the absence of cough, and of all the signs furnished by auscultation, sufficiently distinguish it from hæmoptysis. The colour of the blood from the stomach, likewise, is generally black, while that from the lungs is more commonly arterial. The quantity is also in general greater from the former than the latter viscus, although there are many exceptions to this rule. It should be remembered, also, that blood may pass from the nose into the stomach during sleep, or from the gums after lancing. This disease is one of those, also, most easily and most commonly feigned. The matters thrown up in melæna bear no resemblance to the fluids ejected from the lungs.

Prognosis.—Hæmatemesis is devoid of danger when it arises from pregnancy, from amenorrhœa, and from suppressed hæmorrhoids. When, however, it arises from organic disease of the stomach, from disease of the liver, spleen, or heart, it is always of grave import, although perhaps not immediately fatal. When, also, it is the result of the action of a morbid poison, the danger is likewise often imminent. In melæna the case is always dangerous, but some few recover.

Treatment.—The treatment of the acute forms of hæmatemesis is similar in every respect to that of hæmoptysis, or by the bitartrate of potash, or the mineral acids. The great volume of the arteries of the stomach, and their origin almost immediately from the aorta by means of the cœliac artery, are reasons which have been alleged for this affection being but little influenced by general or local bleedings. The vast amount of blood, also, sometimes lost by hæmatemesis render it necessary to support the patient by acid wines much sooner and to a much greater extent than in hæmoptysis. In melæna the only chance for the patient is a liberal support by wine, diet, and medicines, and by opiates to quiet the stomach.

Entero-Hæmorrhage—Intestinal Hæmorrhage—

Is a hæmorrhage from some portion of the mucous membrane of the alimentary canal below the stomach. It may have its seat in the small intestines, or in the large, or in both, but probably never affects the whole length of the canal.

Remote Cause.—Besides the usual general causes acting upon peculiar idiosyncrasy, and also the many secondary causes, as diseases of the liver, spleen, heart, inflammation, carcinoma, or morbid poisons, there appears to be a few causes peculiar to the production of intestinal hæmorrhage, as worms; also the occasional descent of the gut, which now becoming constricted by the sphincter ani often bursts out with profuse hæmorrhage. It is said, also, that hæmorrhage from the bowels was endemic among the workmen in the mines of Anzin, in consequence of the presence of sulphuretted hydrogen.

Predisposing Causes.—Children are very liable to slight hæmorrhage from the bowels while teething, and at other periods of infancy. It is most common, however, in the adult, and at those periods when the party is most exposed to the action of morbid poisons, and also in advanced life, when the heart and the abdominal viscera become the seat of disease.

Pathology.—If the intestinal hæmorrhage be considerable, the mucous membrane is generally blanched and colourless; but, when more moderate, the point of effusion may often be determined by the mucous membrane being congested, and perhaps infiltrated at the affected portion. The mesenteric vessels are also found gorged. When the hæmorrhage takes place in dysentery the intestine is found ulcerated, and the same phenomenon is often seen in similar cases of typhus fever. The heart, liver, or spleen may be diseased, or an aneurismal or other tumor may exist.

Symptoms.—This affection may assume one of two forms, or that in which the blood poured out is pure; and into that in which the blood, acted upon by the capillaries, is poured out black, pitchy, and grumous, when the disease is termed entero-melæna.

The attack of entero-hæmorrhage may be sudden or be preceded by a series of preliminary symptoms, as pain in the back and loins as low down as the sacrum, and even descending down to the thighs. The patient also may suffer from colic pains, from flatulence, loss of appetite, and other symptoms of indigestion, while the bowels, also, may be either constipated or open.

Of hæmorrhage from the small intestines, Gendrin gives an instance (p. 213) of an unmarried woman, aged twenty-four, and ill of phthisis, who having for about a week experienced dull heavy pain in the loins, side, and umbilical region, with colicky pains recurring often in the twenty-four hours, passed four stools of a reddish brown liquid matter, accompanied by such weakness that she twice fainted on going to the *garde-robe*. She complained of deep-seated pain in the abdomen, and died in the course of the night. On examination tubercles were found, as had been suspected, in the lungs, but the intestinal tube was also filled with dark blood (*rouge violet*) mixed with much grumous matters. The blood was found about three feet from the stomach, and filled the rest of the intestinal canal downwards; the intestine was congested for the space of about five feet, but was in every other respect healthy.

Hæmorrhage from the large intestine is not uncommon, and is far from being attended with those grave consequences attached to that from the small intestines, although the quantity discharged is often great. From this part of the intestine the hæmorrhage is often periodical, and a great relief to persons subject to headache. It also frequently accompanies the hæmorrhoidal flux, which, as the parts are supplied by common ves-

sels, is easily understood. There are instances, however, in which the quantity passed is so great that the patient falls into a state of complete oligamy. One man, in consequence of the descent of the gut, passed about half a pint of blood every other day for many weeks together, till he not only became sallow and dropsical, but was unable to move from his bed; still he recovered. From the general innocent tendency of hæmorrhage from these parts, it is of course intended to exclude those cases in which it proceeds from diseased heart, from dysentery, from scurvy, or from typhus, as well also as from organic disease of the intestine itself.

Diagnosis.—The only disease with which entero-hæmorrhage can be confounded is hæmorrhoids, and their diagnosis is rendered certain by an examination.

Prognosis.—Hæmorrhage from the small intestines, although not necessarily fatal, is always an unfavourable symptom. Hæmorrhage from the large intestines, if idiopathic, is of little moment; but if it be symptomatic, and results from disease of the heart or spleen, from dysentery, or from organic disease of the intestine itself, the prognosis is grave in proportion to the intractable nature of the primary affection.

Treatment.—Idiopathic intestinal hæmorrhage is in all cases best treated by the bitartrate of potash combined with opium, or else by the mineral acids with the same combination. When it depends, however, on descent of the gut, that part should be mechanically supported by a candle or bougie during the act of defæcation; and that this may be practicable the bowels should be kept freely open. If worms should be suspected to be the cause, the oleum terebinthinæ in ʒ ſs. doses presents the most chances of success. The treatment of those hæmorrhages which result from cancer, diseased heart, liver, or spleen, will be mentioned under the head of those disorders.

Hæmorrhoids.—Bleeding Piles.—Blind Piles.

The term hæmorrhoids is applied to certain bleeding tumors which form round the anus and lower portions of the rectum as far as the internal sphincter.

Remote Causes.—Hæmorrhoids are caused by everything that produces plethora of the abdominal vessels. Persons therefore who indulge largely in boiling hot tea or coffee, or who drink to excess of fermented liquors of any kind are liable to this affection. It is remarked also that hæmorrhoids affect those who ride much on horseback, as likewise pregnant women. Perhaps the most frequent cause is habitual constipation.

Predisposing Causes.—In a very few instances hæmorrhoids have been met with in children of six and seven years of age, but twenty to fifty-five is the more common period of life when they occur. Both sexes appear equally subject to them.

Pathology.—The opportunities of examining hæmorrhoidal tumors are frequent, and they are found to be both internal and external. The internal tumors or piles form between the inner sphincter and external edge of the rectum; they consist of a number of small soft hemispherical tumors of four to five lines in diameter, of a violet tint, and formed by an infiltration of blood into the sub-mucous cellular tissue. These tumors may rupture, and much blood escape from them; they also often inflame and become indurated, or else they ulcerate or form small abscesses, which, should they burst and cicatrize, are thus radically cured. The inflammation thus excited may extend to the veins which form the venous plexus of the lower part of the rectum, and these vessels, especially those that are varicose, often become impervious and obliterated. The mucous membrane of the rectum covering these tumors is, by the succession of inflammation and of sanguine infiltration into these tumors, at length rendered so vascular as to bleed on the slightest friction.

The external piles are formed by the action which the sphincter exerts over the tumors thus formed at the edge of the anus, so that at each act of defæcation they become compressed at its orifice, are pressed outwards, and are thus progressively elongated. They at length hang pendulous external to the anus, and by time they become pediculated, hard, and fibrous at their insertion.

When hæmorrhoids are complicated with prolapsus ani, the fibres of the sphincter and of the elevator ani muscles often become atrophied, wasted, and their action impaired.

In the early stages of this affection the blood or lymph effused may be absorbed, and the disease entirely subside. At a more advanced stage some become indurated and of little sensibility, while others again are soft, bleed profusely, are intensely painful, and sometimes rupture or ulcerate. The mucous membrane, which is greatly vascular, is sometimes swollen, sometimes fissured or ulcerated, and these fissures sometimes penetrate so deep as to occasion fistula.

Symptoms. — The hæmorrhoidal tumors produce many unpleasant symptoms, the least of which are a painful teasing action on the patient passing a stool, which is generally hard, constipated, and tinged with blood. Sometimes the hæmorrhoids are so numerous as to fill up the rectum, and should they descend so as to be grasped by the sphincter the pain is often exquisite, and the patient obliged to return the part with his finger.

When inflammation attacks the hæmorrhoidal tumors the pain is often so severe as to extend to the perinæum and testicles in the male, and to the vagina, uterus, and bladder in the female. These pains are much augmented on every motion, even by lifting up the leg, turning in bed, by sneezing or by coughing. In the worst cases every attempt at defæcation is distressing, and dreaded by the patient. Even sleep is at last almost lost, and a grave dysuria often still further adds to the torment of the patient.

The quantity of blood lost is sometimes trifling, but in severe cases it often amounts to many ounces daily. In the former instance the patient suffers little except from the local irritation; but in the latter he loses flesh, becomes exceedingly nervous, and often sinks into a state of melancholy which renders life a burthen.

Diagnosis.—The existence of piles, except they are excessively high in the gut, can always be determined by an examination.

Prognosis.—Piles have seldom any dangerous tendency unless they cause fistula; when operated on they have been known to produce accidents which have terminated fatally.

Treatment.—The medical treatment of hæmorrhoids consists in a few leeches to the margin of the anus, and in the exhibition of the bitartrate of potash so as to keep the bowels gently relaxed. Sulphur has been much insisted on in these cases, but Heberden says it has no greater virtue than any other laxative; Ward's paste has also much reputation.

The diet should be light, and the patient limited to

French and Rhenish wines. It is more important, however, to induce him to abandon hot tea, or coffee, and soups. Perhaps hæmorrhoids would be little known if we drank only cold water. Ablution with cold water should be practised morning and evening; and some persons are sufficiently sthenic even to bear an injection of cold water, but much caution is necessary in the application of this remedy. If the disease resists these remedies the case becomes surgical.

Of Apoplexy of the Liver and of the Spleen.

The liver and the spleen are occasionally the seat of apoplectic effusion into their substance, and may occasion the instant death of the party, or else the disease may become chronic; but even in this latter case the patient falls ultimately, the constitution apparently being unable to restore the parts to their healthy state. The morbid phenomena differ little from what has been described as occurring in pulmonary apoplexy, and these diseases are too rare to render them interesting to the general reader.

Of Hæmaturia.

All those hæmorrhages in which blood is mixed with the urine, whether it proceed from the kidney, ureter, or bladder, are termed hæmaturia.

Remote Cause.—The usual causes of hæmorrhage all act in producing hæmaturia, but there are others peculiar to this disease, as blows on the back or loins, the existence of renal or vesical calculi; also granular degeneration of the kidney, diseases of the bladder, and some morbid poisons, as that of the small-pox or of the scurvy: cantharides and the turpentines are said to act specifically in the production of hæmaturia. A remarkable instance of the effects of the high rarefication of the air in causing this affection is, that one gentleman is said to have been seized with hæmaturia while ascending Mont Blanc.

Predisposing Causes.—Children seldom suffer from this affection; a girl, however, about ten years old, is now in St. Thomas's Hospital labouring under it. It is said to be more frequent among men than women; In either sex, however, it is rare, for Frank states that he saw but six cases out of 4000 patients treated at Pavia, and only one case out of 1913, which he treated in seven years at Vienna.

Pathology.—Hæmaturia is frequently so purely a functional disease that we are often unable to trace whether the blood has flowed from the kidney, ureter, or bladder. In some cases, however, when the hæmorrhage has taken place from the kidney a small clot remains to mark the seat of the disease; also, when it proceeds from the bladder, the coats of that viscus, though often pale, are in a few instances red, congested, and some blood exudes from them on pressure. The most usual organic diseases with which hæmaturia is complicated are, Bright's kidney, fungus hæmatodes either of the kidney or bladder, nephritic and vesical calculi, and cancer of the bladder.

Symptoms.—The hæmaturia may take place suddenly, or it may be preceded for a short time by pains in the loins, epigastrium, or bladder. When the hæmaturia is established the patient suffers a burning pain on passing his urine, which contains more or less blood. Sometimes the blood is deposited in clots in the bottom of the vessel, but more frequently it throws down small portions of fibrine like the sediment from beef tea. In grave cases, especially in old persons with disease of the prostate, the blood may coagulate in the bladder and render it both necessary and difficult to pass the catheter.

The hæmaturia often continues for many days, and even weeks together, and the quantity of blood passed, though often trifling, yet occasionally amounts to some ounces in the course of the twenty-four hours. The general symptoms depend, as in other hæmorrhages, on the quantity of blood lost, but, in general, the termination is a return to health. In other cases, however, the patient sinks with all his faculties about him, and in a still smaller number the fatal catastrophe is preceded by a comatose or typhoid state.

Diagnosis.—No certain symptom has yet been observed by which we can determine the particular seat of the hæmorrhage. We should be careful not to confound urine greatly loaded with uric acid with hæmaturia.

Prognosis.—Idiopathic hæmaturia is rarely a grave disease, except it arises from disease of the kidney, or carcinoma, or other structural disease of the urinary organs, when it is the precursor of a fatal event.

Treatment.—Idiopathic hæmorrhage often readily yields to the bitartrate of potash or to the mineral acids; two cases have lately been cured in St. Thomas's Hospital by the former remedy. Dr. Elliotson recommends the ol. terebinthinæ; other writers recommend injections of cold water, or of water in which twenty to forty grains of alum have been dissolved, into the bladder or up the rectum, and also a cold hip-bath. No remedy has yet been discovered for this complaint when it depends on structural disease of the kidney or bladder. In Bright's kidney, however, Dr. Christison recommends bleeding.

Urethral Hæmorrhage

Is a flux of blood from the urethra.

Hæmorrhage from the urethra is common in a slight degree from an accidental blow or other violence, as the passing a bougie, but it is seldom seen as an idiopathic disease. The following case is all that perhaps is necessary to exemplify this subject.

A man, aged fifty-eight, addicted to the indulgences of the table, and who had taken long walks for five or six successive days in the month of July, was seized with dull pains of the loins, sacrum, groin, and upper part of the thighs, which he considered to be rheumatic. About three days afterwards, on passing his urine he felt a sensation of heat along the urethra, which was followed by some drops of blood, and he bled likewise during the night, but to no great extent. The next day he bled for two hours from the urethra, and lost many ounces of blood. Venesection was now performed, and he was afterwards placed in a cold hip-bath, and the bleeding was thus stopped. The next day, however, the hæmorrhage returned, but was again stopped by the same remedies.

Hoffman and other writers speak of hæmorrhage from the urethra returning periodically after the cessation of a hæmorrhoidal flux.

Of Menorrhagia.

In menstruation the mean quantity lost, as has been stated, is about four ounces, and the time that this discharge occupies is from three to four days, so that the party loses rather more than an ounce a-day. When the menstrual discharge exceeds eight ounces in the

whole period, the quantity is considered abnormal, and the patient is said to labour under menorrhagia. Also if the quantity be natural, but is repeated two or three times within the period, the patient is equally said to labour under menorrhagia.

Remote Causes.—The structure of the uterus is favourable to congestion and to hæmorrhage, for that organ is extremely vascular, and this vascularity is increased when from any cause it acquires an increased volume, as after pregnancy. Extensive venous plexuses, also proper to the neighbouring organs, and especially to the rectum, are connected with the uterus, a circumstance which greatly increases its tendency to become congested. The uterus is likewise fixed to the surrounding parts by loose cellular and other attachments, so that it is easily affected by many shocks and mechanical accidents. As the organ of reproduction, moreover, it is liable to every erotic excitement, and also to abortion, and to the accidents of parturition. Besides these, it is well known that the uterus is powerfully acted upon by every mental emotion, as well as by every ordinary physical cause, so that the exciting causes of menorrhagia are almost endless.

Predisposing Causes.—Lamotte speaks of having seen menorrhagia in a child seven years old. It is, however, a disease proper to adult age, and is most common between twenty-five and forty-five. It rarely occurs after the cessation of the menses, unless the uterus be affected with cancer or other structural disease.

Pathology.—In a large majority of cases menorrhagia occurs without any structural disease of the uterus whatever. The only change is, that the neck and orifice of the uterus are tumefied and softened, but pressure causes no pain. The orifice of the uterus is likewise open, and gives issue to the discharge; and the axis of the uterus slightly deviates forward or to the right. Hæmorrhage of course often exists with every structural disease of the uterus.

Symptoms.—This hæmorrhage may be sudden, but more generally it is preceded by pains in the loins and hypogastrium, aggravated by standing or walking. The patient also often suffers from a vague uneasiness, headache, flushes of the face, abdominal colic, and sometimes diarrhœa; and these symptoms do not subside on the occurrence of the menorrhagia. The hæmorrhage, if abundant, proceeds sometimes without interruption, while in other cases it occurs only at intervals, which are renewed many times in the course of the day.

The quantity of blood lost is very various, sometimes only a few ounces, while in other cases it pours from the vagina with frightful rapidity. The quality of the blood also varies greatly from the healthy secretion in its proportions of serum, of cruor, and of fibrine. In many instances it is so rich in fibrine as to coagulate in clots. In ordinary cases it scarcely coagulates, even in the vagina, and is often only slightly coloured, and these forms often alternate.

The duration of the disease is also very various; when profuse, the hæmorrhage generally begins to diminish in two or three days, and then becomes less and less for the next four or five days. Sometimes there is an alternation of increment and of decrement. In these various manners, although menorrhagia often terminates in six or eight days, yet it sometimes lasts many weeks. One of the most frequent varieties of menorrhagia is when, without being excessively profuse, the menses appear every fortnight or three weeks, and it may happen that the relapses may be still more frequent.

There is, perhaps, no example of hæmorrhage from the unimpregnated uterus terminating in death; but when the quantity lost is considerable, and in a short time, the patient is often thrown into a state of debility which lasts for years. In these cases the general symptoms are a puffed leucophlegmatic sallow face, a throbbing heart, a full quick pulse, with the *bruit du diable*, a high state of nervous excitement, and swollen œdematous legs. The local symptoms are throes like labour-pains, caused by the clots which form in the cavity of the uterus.

Diagnosis.—There can be no doubt that the blood in these cases flows from the uterus; and should that organ have descended and be inverted, the phenomena of menstrual hæmorrhage can be demonstrated. An examination will at once determine the seat of this disease. The violent palpitation of the heart will often lead to a belief that that organ is diseased; but the existence of the hæmorrhage, and the general absence of all *bruit*, however, will instantly remove this supposition.

Prognosis.—Menorrhagia, from a healthy woman, is never of grave prognosis. If profuse, however, there is danger of its laying the foundation of phthisis, or of other severe disease. Even when it results from cancer or polypus, or other disease of the uterus, the patient rarely falls from mere loss of blood.

Treatment.—It seldom happens, when the patient has the ordinary comforts of life, and submits to a proper dietetic treatment, that menorrhagia resists ʒ j. of the bitartrate of potash every four or six hours, combined, perhaps, with half a grain of opium to each dose. The mineral acids are, perhaps, in many cases equally beneficial. The secale cornutum, by causing contraction, is certainly useful in the hæmorrhage which takes place during parturition; but the unimpregnated uterus is in a state of contraction, and the exhibition of this medicine therefore has very generally failed in cases of ordinary menorrhagia. Gendrin says he has often seen it exhibited in the hospitals in Paris in simple menorrhagia, not only without advantage, but with a manifest exasperation of the disease: "il nous a paru évident que les accidents ont été exasperés." In very obstinate dangerous cases dry cupping, a cold lavement, ice to the vulva, and compresses steeped in a solution of alum and passed up the vagina are strongly recommended.

In very chronic cases some tonic remedy should be combined with the bitartrate or the mineral acids, as the sp. ætheris nitrici ʒ j. Other practitioners, however, prefer some preparation of iron, or kino, or even of quina.

The general and dietetic treatment consists in keeping the patient quiet, placing her on a hard cool bed in a well-aired room. All the fluids drank should be cold; but if she should be greatly exhausted or greatly excited, some small portion of wine may be mixed with her drink. No meat should be allowed on any pretext.

Of Dropsies.—Hydrops.—Order III.

Dropsy is the accumulation of a watery fluid in the serous cavities or cellular tissue of the body, constituting a class of diseases which have been treated of in the writings of Hippocrates, and subsequently in those of every school of medicine.

Dropsy may arise from a disordered action of the

solids, or from a morbid state of the fluids. Lower appears to have been the first to demonstrate that a diseased liver or diseased heart would, by opposing an obstacle to the circulation, cause dropsy, and for this purpose he tied the vena portarum of a living dog, when the animal fell into dropsy. Dropsy, however, often exists when no obstruction can be discovered, and is evidently owing to a change in the vital affinities of the capillaries, either from mere disordered function, or else from a low inflammatory action. Besides alterations of the solids, dropsy may result from a diseased state of the fluids, and more especially when the albumen or red globules are greatly deficient; thus, in chlorosis, or after large bleedings or profuse hæmorrhage, by which the colouring matter of the blood is greatly reduced, the patient often falls into dropsy. Those states of the kidney likewise by which the serum of the blood is deprived of its albumen, also for the most part cause dropsy. The extent of the loss thus sustained may be conceived, when Andral states that in sixteen cases of dropsy he found the maximum of albumen to be only forty-eight, while the minimum was reduced as low as four, the healthy proportion being as sixty-seven. If the aqueous portion be from any cause sensibly increased, dropsy appears to be the result. Majendie, for instance, injected large portions of aqueous fluids into the veins of an animal which immediately became dropsical in all its cavities. Whatever consequently causes the suppression of a copious secretion from any membrane may be a cause of dropsy. Thus exposure to cold and wet is a very common cause; and to show that in these cases it most probably arises from suppressed perspiration, a man was varnished all over, when he is said to have fallen into dropsy. Dropsy also, it will be seen, often results from a morbid state of the fluids as from their combining with a morbid poison, as with the paludal poison, or with that of scarlet fever. It is evident, therefore, dropsy may arise from a morbid state, either of the solids or fluids, or both. The fluids effused in this disease into the various cavities of the body have been imperfectly analyzed by Dr. Marcet; they have, however, a general resemblance in whatever part of the body they may exist, but vary exceedingly in the proportions of their constituent ingredients. They are as follows:—

In 1000 Grains of Fluid.	Specific Gravity.	Total Solid Contents.	Animal Matter.	Saline Matters.
		Grains.	Grains.	Grains.
Fluid of Spina bifida.	1007·0	11·4	2·2	9·2
,, Hydrocephalus	1006·7	9·2	1·12	8·08
,, Ascites . .	1005·0	33·5	23·1	8·4
,, Ovarian dropsy	1020·2	..	..	8·0
,, Hydrothorax	1012·1	26·6	18·8	7·8
,, Hydrops pericardii . .	1014·3	33·0	25·5	7·5
,, Hydrocele .	1024·3	80·0	71·5	8·5
,, A blister . .	1024·1	..	..	8·1
,, Serum of the blood . .	1029·5	1000·0	90·8	9·2

12,251 cases of this class of disease are reported to have died in England and Wales in 1839, or about one person in twenty-eight.

Hydrocephalus Acutus is an effusion of serous fluid between the membranes of the brain, or else into its ventricles.

Hydrocephalus was very little known till Dr. Whytt published his *Observations on Dropsy of the Brain*, in 1768, but since that period Dr. Fothergill, Dr. Watson, Dr. Dobson, Dr. Cheyne, and a large number of other writers have contributed to illustrate this disease. 7749 patients are said to have died from it in England and Wales in 1839.

Remote Cause.—The remote cause of this affection is often extremely obscure; but exposure to cold or heat, errors in diet, falls or blows on the head, the retrocession of a cutaneous eruption, or an extension of an inflammation of the ear, are among the most common. Disordered function of the liver or alimentary canal is also a frequent cause, and so is dentition, or the presence of worms; and the circumstance of a child being seized in consequence of its feet having by accident been put into a bath of boiling water, will show that any other high irritation will equally produce it. Many morbid poisons also will occasion it, as that of scarlet fever, of pertussis, or of measles; of organic diseases, tubercles of the brain are the most common exciting cause.

Predisposing Causes.—The epochs of infancy and childhood are the most remarkable for predisposing to this disease; for at those periods the rapid growth of the brain, the irritation of dentition, and the great susceptibility of the nervous system generally, are all powerful causes of determination of blood to the head. The greatest number of attacks, according to Percival and Brichtean, occur between the second and the fifth year; or, as a more general law, it occurs from the infant at the breast to twelve years old. Children with large heads and precocious intellects, and more especially those of a scrofulous diathesis, are its most frequent victims. One warning may be learnt from this disease; that it is most common in the children of parents addicted to drunkenness, and from this cause it often runs in families.

Pathology.—There are a few cases in which effusion of serum into the ventricles, or into the cavity of the arachnoid, is unaccompanied by any morbid appearance of the brain or of its membranes whatever, so that hydrocephalus is essentially a mere functional disease. More commonly, however, some lesion of the brain or its membranes does exist; thus the substance of the brain is often marked with more bloody points than usual; the septum lucidum, the fornix, and other parts forming the walls of the ventricles, are often found in a state of softening, sometimes so soft that Golis gives a case in which water could be expressed from it as from a sponge. The membranes also are sometimes found congested, or opaque and thickened, with spots of lymph, evidently the effect of a low inflammation.

The quantity of fluid effused varies from a few teaspoonfuls to seven or eight ounces; and of this the greatest part is generally contained in the lateral ventricles, which from this cause are often so enlarged and distended that the finger placed on the brain immediately over the ventricle is sensible of a distinct fluctuation, while the anterior portion of the fornix is often so raised as to cause a free communication with the third ventricle, and, perhaps, with the fourth, at least the effused fluid is found likewise distending those cavities. The quantity of fluid effused between the membranes is also often great, sometimes filling the whole cavity of the arachnoid as well as the ventricles. Dr. Abercrombie has found serum effused even between the cranium and dura

Elementary Principles of Medicine.

mater, and so also have Bonet and Guding, a circumstance hardly known in any other disease. The choroid plexus or ventricular membrane, although in general pale and healthy, yet sometimes has the intercellular tissue so infiltrated that it is studded with small cysts like a bunch of currants.

The more frequent accidental occurrences are tubercles in the brain or membranes, and some congestion, perhaps, of the mucous membrane of the intestinal canal; but whether the latter is a primary affection or the result of the violent medicines which are generally had recourse to in this affection is not determined. Dr. Joy has remarked that the peculiar green colour of the stools was imparted in the lower portion of the intestine, the fæcal contents of the upper portion being of a pale drab colour, while the bile in the gall-bladder was of a yellow colour.

The pathology of this disease explains no phrenological fact. The child is highly irritable, peevish, and fretful; so if any conclusion is to be drawn, it must be that there is a connexion between the ventricles and the passions.

Symptoms.—Authors have greatly differed as to the nature of this disease, some considering it a mere dropsy, while others have as constantly referred it to an inflammatory origin, but they have generally concurred in dividing it into acute and chronic.

Acute hydrocephalus is divided into three stages; the first stage, according to Dr. Cheyne, being that of increased irritability; the second, that of diminished sensibility; and the third, that of convulsions or palsy.

The first stage may be either sudden in its attack, or be preceded several days by giddiness, so that the child stumbles or falls at play; by a furred tongue, constipated bowels, and, perhaps, offensive breath. At length the senses of sight and of hearing become morbidly acute; he starts at slight noises—complains of intermitting headache—rests his head on his nurse's lap—cries, "Oh! my head, my head!" and then after a time rises up and plays again. As this stage advances the pulse rises, the skin is hot and dry, the urine scanty, the stomach irritable, the bowels constipated, perhaps painful, the stools black and offensive, while the brow is knit, and the pupil of the eye contracted or expanded. The most remarkable feature, however, is a great fretfulness of temper, so that the child is not merely pettish, but quarrelsome. If he sleeps his sleep is short, uneasy, meaning; he also grinds his teeth, rolls his head, and when he wakes up it is with a scream. To sum up the phenomena of this stage in the language of Dr. Cheyne, "We are led to suspect some deeply-seated evil from the frantic screams and complaints of the head and belly, alternating with stupor, or rather lowness, and unwillingness to be roused."

The second stage commences when effusion has taken place; and now the pulse, instead of being rapid, is as slow, perhaps slower than natural, but this is chiefly when the patient is in a horizontal position, for if he attempts to sit up it again becomes rapid; the sickness is also abated; nevertheless the child lies in a state of stupor and of great unwillingness to be moved, with his eyes half-closed, dull and heavy, or else staring or squinting, the pupil being still contracted or expanded, and he often suffers from double vision. The stupor, however, is still interrupted by exclamations or shrill piercing screams, while the tremulous hand of the little sufferer is incessantly engaged in picking his nose or mouth.

In the third stage the patient either sinks or else recovers. If the event is unfavourable the pulse again rises, the eye becomes red and dim, and the child, delirious, is often attacked by partial or general convulsions, or else one limb or one side may be palsied. From this point the powers of life gradually sink, till at last death closes the affecting scene. If the patient should fortunately recover, the stupor subsides, the countenance becomes more natural. the bowels more regular, the secretion of urine perfectly restored, and at length his health, though long broken, is gradually re-established.

The duration of this disease is estimated at about three weeks, each stage averaging about a week.

Diagnosis.—Hydrocephalus is distinguished from typhus by the screaming, rolling of the head, grinding of the teeth, and by the absence of the peculiar tongue which marks the latter disease.

Prognosis.—The chances of recovery in the first stage are very many if the patient be properly treated. At any subsequent period the prognosis is most unfavourable, and Dr. Cheyne estimates the loss of confirmed hydrocephalus at six to one, and perhaps this is near the truth.

Treatment.—This disease is only successfully combated in the first stage; and the first thing to be done is to purge the patient. The purgative is not of great moment, provided it acts freely. Some prefer gamboge, grs. v. 6^{tis}; others, calomel grs. ij. to grs. v., with jalap or scammony grs. x. to grs. xv., or the same quantity of the extracti colocynthidis comp.; and this dose is to be followed up by a black draught, or the sulphate of magnesiæ. The stools are generally black, or extremely offensive; and this state of the bowels corrected, the disease, if sympathetic, often ceases. If, however, the head be not relieved, some leeches should be applied to the temples, and the head should be shaved and surrounded with some cold evaporating wash, as with a towel dipped in cold spring water, or in vinegar and water, &c.

If the disease be further advanced, no efficient treatment has as yet been determined. Many practitioners have attempted the cure by copious bleedings, but the symptoms do not yield to the lancet like those of simple inflammation. Mercury has also been used to a great extent, but with little success. In urgent cases, for instance, mercury has been rubbed on the back and thighs, even in very young children, to the extent of half a drachm to ʒ j. three or four times in the twenty-four hours. Calomel also has been rubbed on the gums to the extent of three or four grains every four or five hours; and it has likewise been given by the mouth in doses of two grains every third or fourth hour. Mercury given in these large doses, it must be remarked, seldom produces salivation; for Dr. Clarke says he never saw that effect in children under three years of age, except in three cases; but it is not successful, and more generally produces *spinage* stools, irritates the alimentary canal, and perhaps does harm. In France the mercurial treatment has been so unsuccessful that some practitioners have even tried a most opposite remedy, or quina, but the result has been equally fatal. Blisters, moxas, and other modes of cauterization have been used as auxiliary treatment, but without apparent benefit.

Dietetic Treatment.—During the whole course of this disease the treatment should be slops and light puddings.

Hydrocephalus Chronicus.—This affection may be congenital, caused by some disease or else defective development of the brain during fœtal life, or it may occur at some period in after-life as an original disease.

Remote Cause.—The remote causes are little understood, but as far as they are known they are similar to those producing hydrocephalus acutus.

Predisposing Causes.—This disease, it has been stated, may occur during fœtal life, but is more common in the early periods of infancy and childhood. Adult age is not altogether free from it, and Golis has mentioned three cases of persons attacked in old age, two of whom were above seventy, while the other, perhaps less advanced in life, suffered from this affection for ten years. It seems sometimes to run in families; at least Frank mentions a family of seven children, all of whom were born with this disease; and Golis, another, in which six children were aborted hydrocephalic at six months; while three others, born at the full period, were attacked shortly after birth. The sexes appear to be equally liable to it, or nearly so, as 4313 males and 3436 females died of it in 1839.

Pathology—The first thing that strikes us on examining these patients is the enormous *size* of the head. The adult head averages about twenty-two inches in circumference; but there was in St. Thomas's Hospital a child, Elizabeth Phillips, whose head measured, at eleven months old, twenty-seven inches and five-eighths; while Dr. Bacon* gives the case of a child whose head at three months had attained the enormous size of twenty-nine inches in circumference. The head of Cardinal, also a celebrated hydrocephalic man, long in St. Thomas's Hospital, and who afterwards died at Guy's, measured thirty-three inches and a half. There are instances, however, in which the cranium has been found unusually small, and of a conical shape, the sutures being closed before birth, and in this case the child is still-born, or dies shortly after delivery. When the disease comes on at later periods of life, and after the sutures are closed, the size of the skull is natural.

The *form* of the hydrocephalic head is also sometimes very irregular, one side being much larger than the other, while the base of the orbits is for the most part convex instead of concave, thrusting the eye unnaturally forwards. On cutting through the skull the bones are found to be remarkably thin and transparent. The sutures also, although generally closed towards the base of the skull, are commonly separated from each other by a wide extent of membrane at their superior portions. If, however, the patient should survive for several years, the membranous portion becomes ossified by a number of points forming "ossa wormiana," and the sutures are thus partially closed. In some very few instances the sutures not only close, but the bones of the skull have a morbid thickness, which thick and large skulls, Dr. Joy conceives, on being dug up have been mistaken for those of giants.

The membranes of the brain are generally thickened, and the water found effused either into the cavity of the arachnoid, into a cyst, or into the ventricles of the brain. When the water is contained within the cavity of the arachnoid, the brain is sometimes so compressed that there are instances in which hardly a vestige of that organ remains. A singular and rare variety of this affection is, that the arachnoid sometimes protrudes through the fontanelle or open suture, and the dura mater and integuments yielding, a pyramidal bag with its apex downwards forms externally, which hangs low down the back like a jelly-bag.

* *Med. Chir. Trans.*, vol. viii.

When the effused fluid is contained in the ventricles, those cavities are found exceedingly dilated. The convolutions have no depressions, but appear unfolded. The corpus callosum is much raised, the septum lucidum is torn and destroyed, so that the ventricles communicate. The parts at the base of the brain also, as the corpora striata and thalami opticorum, have scarcely any existence. In fact, the brain seems expanded into a large sac, in which the medullary and cortical substance are so confounded as to be undistinguishable. In Dr. Bacon's case the brain and membranes, even the dura mater, had ruptured, and a probe passed easily through the ethmoid bone into the nose, by whose orifices a considerable dribbling of the fluid took place during life. Golis met with a case in which the water was contained in a cyst the size of a goose's egg, situated between the hemispheres of the brain of a child aged six years, and who died, the cyst being entire.

The quantity of fluid contained in the cranium in hydrocephalus chronicus varies from a few ounces to a few pounds. In the case of Cardinal it was found to exceed ten pints, or nine pints in the cavity of the arachnoid and one pint in the ventricles. Other cases have been, however, recorded in which the quantity has amounted to twenty pints.

Symptoms.—There are two forms of chronic hydrocephalus, the internal and the external or jelly-bag hydrocephalus. In either case, when this disease is fully formed, whether it be congenital or subsequent to birth, the child is generally of most feeble intellect, irascible, often epileptic, and of extreme muscular debility, so that if not palsied he is hardly able to walk. Dr. Baillie met with an instance of chronic hydrocephalus in a man aged fifty-six, and whose ventricles contained six ounces of serous fluid, and his chief symptoms were pain in the head, and a loss of memory so great that he could recollect only five words, which he continually reiterated to express all his wants. Cardinal, whose case has been mentioned, had more memory, and he prided himself, says Dr. Elliotson, in being able to say "The Belief," but he usually stumbled when he got to Pontius Pilate. This man was epileptic, of very feeble intellect, and so irascible as to be always quarrelling with the patients, and would have been extremely difficult to manage except for his muscular debility. Heberden, however, mentions a case in which eight ounces of water were found in the ventricles, and yet no symptoms of hydrocephalus existed during life.

Diagnosis.—The external characters of chronic hydrocephalus are so extremely marked that it is hardly possible to mistake them.

Prognosis.—The immediate danger in these cases is not great, but few patients survive the age of puberty; Cardinal, however, lived to the age of thirty-two. Aurival speaks of another instance which reached forty-five; and Gall of a third who survived till fifty-four.

Treatment.—In congenital hydrocephalus the unassisted efforts of nature seem incapable of effecting a cure; and it is extremely problematical if medicine has been of any use. When, however, the case is pronounced hopeless, the propriety of evacuating the water by means of an operation may be entertained. Golis has given the names of twenty-seven writers who have expressed themselves in favour of it, especially if the fluid be slowly evacuated, and at several repetitions of the operation; yet he himself, along with seven or eight

Elementary Principles of Medicine.

others, including Boerhaave, proscribe it altogether as cruel and useless; however, it has been successful.

When the operation is performed, it seems an axiom that the fluid should be allowed to escape gradually, for otherwise extreme faintness and collapse may be expected. In such casc small doses of ammonia, or a few tea-spoonfuls of brandy and water shortly revive the little patient. Should, however, at a subsequent period, re-action take place, a few leeches and a cold lotion ought to be applied to the head.

It seems also determined, that the younger the child the more chances of success; for if it lives a few years, the sutures of the cranium, though open at the top, are united by bone towards the base of the skull, and thus present a mechanical obstacle to the closing of the sutures, and consequently the operation must fail.

If this disease should occur in after-life, blisters and mercury to salivation are the remedies most relied on.

Hydrorachis, spina bifida, or dropsy of the Spine, is an excess of serous fluid in the cavity of the Spine. This is, for the most part, a congenital disease, and, in its rarest forms, the fœtus is born without a spinal cord, the membranes forming a sac filled with fluid. In other cases the axis of the spinal cord is open, as in fœtal life, and filled with fluid; while in others the spinal cord is perfectly formed, only compressed by the quantity of water by which it is surrounded. In the more usual form of the disease there is found one, more rarely two, external swellings, containing fluid. The form of these watery tumors is flat, semilunar, or pyramidal. They are formed by the expanded membranes of the cord, covered with the common integuments. The cleft by which they communicate with the spinal cavity varies greatly, and usually results from one or more vertebræ being defective; in rarer cases, by a round aperture in one of the vertebræ, and still less frequently by a similar aperture between an intervertebral space. The symptoms of hydrorachis are debility, emaciation, and very generally palsy, as well as anæsthesia of the lower extremities, resolution of the sphincters, inability to take the breast, and convulsions. The life of the child usually terminates at birth, or shortly after; but in some few instances the party attains a greater age. Paletta met with one patient seventeen years old; Henderson saw another at eighteen; Warner, one at twenty; Camper, one at twenty-eight; and Cowper, one that survived till thirty. Dr. Copland, in 1822, saw a young woman aged seventeen, who, in addition to the singularity of hydrorachis, menstruated regularly from two ulcers in the thighs. The tumor in this case measured thirty inches in circumference, and she passed her fæces involuntarily. She was in good health at this period, but died a few months afterwards. No efficient treatment, perhaps, exists for this disease.

Dropsy of the Organs of Respiration.

Angina Œdematosa—Œdema of the Glottis—Hydro-glottis—is an effusion of serous fluid around and into the lips of the glottis.

Remote Cause.—This disease is occasionally idiopathic; often preceded by other forms of dropsy; and it is also in some instances the result of inflammation. When this form of angina is idiopathic, it probably most often results from cold or wet; when t is preceded by other forms of dropsy, those dropsies are usually caused by the poison of scarlet fever, or of the paludal fever.

Predisposing Causes.—When œdema of the glottis is idiopathic, it has occurred most frequently in the adult between fifty and sixty. When preceded by other dropsies, it is most common in early adult age; and when it results from inflammation, most usual in children.

Pathology.—In these cases the loose sub-mucous cellular tissue of these parts is seen distended with a colourless serous fluid, sometimes merely closing the lips of the glottis, but at other times swelling out as big as an egg. If the disease be idiopathic, or the termination of dropsy, no redness is present. If, however, it is the result of inflammation, the quantity of fluid effused is less, but the tissues are red, injected, thickened, and easily torn.

Symptoms.—This disease, if idiopathic, or caused by dropsy, is usually sudden in its attack, the patient being seized most unexpectedly with a difficulty of breathing and a sense of suffocation, which shortly arises to orthopnœa. The head is now thrown backwards, the countenance becomes purple, the hand of death is on the patient, and for the most part he dies in a few minutes suffocated.

Diagnosis.—Œdema of the glottis is distinguished from œdema of the lung by the chest being perfectly sonorous.

Prognosis.—The prognosis is, in every case, most unfavourable.

Treatment.—The treatment of this disease is necessarily energetic, and the two following cases will exemplify this axiom. Two patients, both of them females, about forty, were brought on the same day to St. Thomas's Hospital, and as nearly as possible in the same state of idiopathic œdema of the glottis. They had been ill a very few days, and they now suffered from loud croupy breathing, orthopnœa, purple lips, and the other symptoms which have been described, but otherwise they had not suffered greatly in health. One was bled and blistered; the other was bled, blistered, and took mercury so as to affect the mouth. The latter recovered, while the former died. On examination, the cartilages of the larynx were ossified, but the cause of death was simple œdema of the glottis. In extreme cases it is, perhaps, right to perform tracheotomy.

Œdema of the Lungs—Hydro-pulmonalis—is an effusion of water or serum into the cellular tissue of the lungs. Laënnec says this disease, though common at the time he wrote, was nevertheless very little known. He thinks Albertini and Barrère, of the military hospital at Perpignan, first described it in 1753, but failed in attracting the attention of the profession to it.

Œdema of the lung is, in a very few instances, a primary disease. More commonly it occurs at the close of other dropsies, and in some few instances results from inflammation: its remote and predisposing causes are little known.

Pathology.—On opening the body in these cases the lung not only does not collapse, but bears the impress of the rib; and if the finger be forcibly placed on it, the impression remains. If the lung be now cut into, a colourless transparent serum flows from it; but its structure is healthy, although often of a pale yellow or greenish colour, being stained by the effused fluid. The accidental conditions are bronchitis and pneumonia, in the first or second degree, and diseased states of the heart.

Symptoms.—The symptoms which denote this affection are a sudden and great difficulty of breathing, incapability of lying down, cough, with a more than usual fluid expectoration. The face also is livid, and the pulse rapid.

If the effusion be considerable, the respiration is loud and tracheal, while a dull sound is returned all over the chest. If of less amount, the *râle* is subcrepitant, while sufficient air penetrates the lung for the chest to return a natural sound.

Diagnosis.—This disease is to be distinguished from hydrothorax, and the diagnosis is difficult; but the change of position does not so distressingly and immediately affect the patient's breathing in this disease, the water more slowly gravitating towards the root of the lung. The phenomena of ægophony are also wanting in this affection.

The *Prognosis* is always most unfavourable, and the patient seldom survives more than a few hours.

Treatment.—If this disease is ever idiopathic, it probably must destroy the patient even before our most active remedies can act upon the system; but the only chance for the patient must be energetically to use perhaps mercury and the bitartrate of potash.

Hydrothorax is the effusion of water into the cavity of the chest, and was a disease known to Hippocrates, who proposes the singular practice of shaking the patient, in order to determine the existence of the disease. 2149 cases are said to have died of this disease in England and Wales in 1839.

Remote Cause.—Hydrothorax is occasionally a primary idiopathic disease, and is the result of all the usual causes of dropsy, as cold, wet, or intemperance. In other cases it results from disease of the heart, liver, or other causes obstructing the circulation. Inflammation of the pleura is also a cause; and often results from the action of a morbid poison, as the paludal poison, or that of scarlet fever.

Predisposing Cause.—Hydrothorax is infrequent in children, and not common till after the age of forty, when the viscera become disorganized, and low inflammations are readily set up. It occurs in both sexes in the ratio of 1199 males to 950 females, or as ten to twelve nearly.

Pathology.—In idiopathic hydrothorax, the chest, on being opened, is found more or less full of water, which being removed, the pleura is seen sometimes healthy, but more generally of a dark colour, a quantity of venous blood being congested in the vessels from deficient oxygenation. The fluid may be effused into one or into both cavities of the chest. It may also be limpid and colourless, like water; but more commonly, perhaps, it is citron-coloured, and contains much albumen. The quantity effused varies from a few ounces to many pints: eight and nine pints are not unusual; and Laënnec states that he once removed twelve pints from the right side of the pleural cavity. When the quantity of fluid is large, the lung is thrust up under the sternum, and so compressed as to be sometimes no bigger than the fist.

When hydrothorax is secondary, almost every chronic affection, either of the liver, kidney, or heart, may be found co-existing at the same time. Occasionally it is the result of pleuritis, and in these cases the serum is more flocculent, contains more albumen, and portions of lymph are often also seen adherent to the pleura pulmonalis, or pleura costalis: the two pleuræ are also often more or less united.

Symptoms.—The effusion may take place either gradually or suddenly. In the former case it may be so slow that the lung is able to adapt itself to the presence of the accumulating fluid, and the symptoms will consequently be much less marked, although the effusion be large. In the latter case the functions of the lung are almost at once suspended, the countenance livid, the breathing greatly disturbed, and the patient perhaps has hardly time to rush from his bed before he expires in the paroxysm.

When the effusion is slow, the symptoms are difficulty of respiration, which is carried on rather by the shoulders and diaphragm than by the intercostal muscles, some expectoration, lividity of the face or lip, œdema of the legs, and either a very full labouring pulse, or else one that is small, frequent, and intermitting: the urine also is extremely scanty. As long as the effusion is moderate, the patient is unable to lie down, from the sense of suffocation produced by the fluid gravitating towards the root of the lung, and compressing the larger bronchi, and he therefore sits propped up by pillows, with his head bowed forwards. In the event, however, of the effusion being so considerable that the function of the lung is entirely suspended, the patient can lie flat in his bed without experiencing any inconvenience.

When the effusion is sudden and of some amount, and the patient survives the first attack, the dyspnœa is liable to severe exacerbations, and is well represented by Dr. Darwell (*Encyclopædia of Medicine*):—"in a tray-painter these paroxysms came on every morning between two and three o'clock, and lasted for an hour or more. This man was compelled, by a sense of suffocation, to start out of bed, and while the attack lasted he placed himself against an open window, gasping in the most terrific manner for air. His death took place suddenly, and on examination the lungs were found to be œdematous. Upwards of two quarts of serum were contained in the cavities of the pleuræ, and a few ounces of coffee-coloured fluid in the pericardium. The only other morbid appearance in the whole body was hypertrophy of the left ventricle.

When hydrothorax is symptomatic, or consecutive of affection of the heart or of other disease, it is generally preceded by swelling of the legs or eye-lids,—by the urine being plentiful and albuminous, or else scanty, high coloured, and loaded with the usual salts,—and indeed by most of the symptoms of dropsy generally. In these cases the effusion seldom takes place into the chest till a few days before death, rendering the agony doubly painful and suffocating.

When the effusion is moderate, auscultation gives bronchial respiration, some mucous rhoncus, and also bronchophony, and occasionally that undetermined condition called ægophony, which is a broken sound like the bleating of a goat, or the amusing notes used in the exhibition of Punch, and which is heard as though the patient was speaking at the end of the stethescope, but not through it. This singular phenomenon is heard only in the back, and when the instrument is placed, as is supposed, about the level of the effused fluid. When the effusion is more considerable, the respiration is almost tracheal,—there is neither bronchophony nor ægophony, and a dull sound is returned over a greater part of the chest. Again, if the patient's chest be bared, there is no expansion on the side of the seat of the effusion, the respiration of that part being carried on altogether by the shoulders and diaphragm; and should the effusion be

Elementary Principles of Medicine.

Elementary Principles of Medicine.

excessive, the affected side bulges out, as in empyema, and its intercostal spaces are enlarged and prominent.

Diagnosis.—The absence of pain, and of the other symptoms of inflammation, distinguish this disease from acute pleurisy. Should, however, the pleurisy be chronic it is impossible to distinguish the two diseases, except by the previous history. The diagnosis also between hydrothorax and œdema of the lung is, as has been stated, most difficult.

Prognosis.—Some cases recover from hydrothorax, but they are few, so that the prognosis is in all cases extremely grave and unfavourable.

Treatment.—The treatment of hydrothorax is of great difficulty, from the many causes on which it may depend, and also from the almost uniformly intractable nature of the disease. As a general principle, mercury combined with squills, digitalis, or the bitartrate of potash, and pushed so as to affect the mouth, is among the most valuable of our remedies. It is much more efficacious in this form of dropsy than in ascites, and it is remarkable in many cases to observe how immediately the symptoms are arrested as soon as the gums are touched. Should this treatment fail, we must have recourse to gamboge or to other purgatives or diuretics, and of these some one perhaps may be found to succeed, yet much more commonly they all fail. With respect to bleeding, it seems only admissible in two cases, and then only to a moderate amount, as when hydrothorax supervenes on pleurisy or on disease of the heart with expectoration of blood. The general want of success attending the treatment of hydrothorax has induced some practitioners to propose the operation of paracentesis of the chest. It is questionable whether any case is on record of a successful result of paracentesis in cases of idiopathic hydrothorax; but there seems no reasonable objection to the operation when all other methods are hopeless. It should be borne in mind, however, that both sides in all probability must be tapped,—that the operation is not without danger, both from the wound and from the admission of air into the cavity of the pleura; also, that it has no power to remove the hydropic diathesis; and, lastly, that it is extremely likely the disease may co-exist with œdema of the substance of the lung.

Hydrops Pericardii.

Hydrops pericardii is a collection of water in the pericardium.

Remote Cause.—Hydrops pericardii occurs in a few instances as an idiopathic disease, and probably results from the causes of dropsy in general; more commonly it results from inflammation, and that inflammation may be caused by rheumatism, by the paludal poison, or by the poison of scarlatina. In other cases it is only the last stage of some other form of dropsy.

Predisposing Causes.—When hydrops pericardii is idiopathic, it usually occurs before the age of puberty; when caused by a morbid poison, it is more common in adult age; and when from previously existing disease, it occurs chiefly between 40 and 60. Both sexes are liable to this disease, and perhaps in nearly equal proportions.

Pathology.—In hydrops pericardii there is no alteration of structure, says Laënnec, of the heart or of its membranes. Some authors have stated that the heart is macerated in these cases; but such writers, he adds, must have badly observed, and still worse expressed, what they have seen. When it is the result of inflammation, the usual appearances of pericarditis are found. The fluid contained in the pericardium is usually limpid, without any flakes of albumen. Most commonly it is colourless, but occasionally it is of a citron or red hue, from containing a small portion of the red particles of the blood. Its quantity is very various; sometimes a few ounces, sometimes two or three pints; while Corvisart states that he met with one case in which it amounted to eight pints. The smallest of these quantities is in great excess, for Dr. Darwell has given the results of the examination of 150 bodies, dead of all diseases, and he found that in 30 only out of that large number was there any appreciable quantity of fluid found in that cavity. It seems probable, therefore, that during life the secretions of the pericardium exist only in a state of vapour.

Symptoms.—If we consult those authors who have treated on dropsy of the pericardium, we find little agreement among them of the pathognomic signs of this disorder. Lancisi considers the leading symptom to be the sensation of an enormous weight in the præcordial region. Reimann and Saxonia assure us that the patient feels his heart swimming in a great quantity of fluid. Senac has seen, in the third, fourth, and fifth intercostal spaces, the waves of the effused fluid; and Corvisart says he has felt them. The latter physician adds to this symptom a sense of weight at the heart—a greater dulness on percussion; a pulse small, irregular, and frequent; together with a tumultuous but obscure action of the heart, as if it moved in a larger circle. He speaks also of frequent syncope,—of general œdema,—and of the patient being unable to lie down in bed. Rostan is so dissatisfied with all that has hitherto been observed respecting the diagnostic symptoms in this disease, that he affirms it can only be determined by a process of negation, or, that when we are unable to refer the existing symptoms to any other assignable cause, we may infer that they can be owing to no other circumstance than water in the pericardium. A youth, about 15, was admitted some years ago into St. Thomas's Hospital labouring, as was supposed, under a slow fever. The fever subsided, when he suffered much from cough and affection of the chest. It was not phthisis, for he did not expectorate; it was not hydrothorax, for he could lie down; and it was not pneumonia or pleurisy, for there was no pain or other symptom of these disorders. It was therefore inferred it was water in the pericardium; and, on laying the hand on the cardiac region, the heart was found to be beating feebly but rapidly, and on spanning the limits of its apparent action, it was found moving in a space of several inches. The diagnosis was consequently water in the pericardium; and on examining the poor lad, who died some weeks after, three to four pints of fluid were found in the pericardium, without any other existing disease.

Laënnec says he has had but few opportunities of observing dropsy of the pericardium, and is doubtful if the stethescope would be useful in determining the disease. He thinks percussion and inspection would not detect less than a pint; but should the water exceed two pints, he thinks these means would determine it.

Diagnosis.—The difficulties attending this question have been already stated; and these difficulties are increased by the fact, that effusion into the pericardium was found by Chossat in all the animals killed by him in his experiments on inanition. Consequently a similar effusion in all probability takes place in many chronic diseases when the agony has been long, and is one of the last phenomena of waning life.

Prognosis.—Always most unfavourable.

Treatment.—Laënnec thinks we may cease to regret our imperfect knowledge of the symptoms of hydrops pericardii on account of the few resources we possess for the cure of this malady; for mercury, digitalis, the bitartrate of potash, as well as every other class of medicines, have been found powerless against it. Under these circumstances paracentesis has been recommended; and if performed, Laënnec advises trephining the sternum above the ensiform cartilage, which would enable us to see and touch the pericardium, and even to inject a fluid, if thought advisable.

Ascites—(ασκος, a bladder)—

Is a collection of serous fluid in the cavity of the abdomen. Only 120 deaths are recorded to have died of this disease in England and Wales in 1839; but 12,251 are stated to have died of dropsy of uncertain seat, and a large proportion of these must have contained water in the abdomen.

Remote Cause.—The remote causes of this form of dropsy are the same as those of dropsy of the chest; but those causes act more energetically on the peritoneum than on the pleura. Ascites, for example, is more frequently produced by large bleedings, by phthisis, and by disease of the heart or kidney, than hydrothorax. Tumors, also, obstructing the circulation, are more frequent in the cavity of the abdomen than of the chest. Changes of temperature, morbid poisons, a diseased state of the intestines, or of the liver, or of the spleen, are also causes which act more frequently in the production of ascites than of hydrothorax. In the female, also, many peculiar causes are in action to produce ascites: thus ascites sometimes follows parturition. Two cases of ascites were lately in St. Thomas's Hospital from the parties wearing large pessaries. Ovarian dropsy also frequently terminates in ascites.

Predisposing Causes.—Every age is liable to ascites, from the infant at the breast to the extremest period of decrepitude; in general, however, ascites is rare before puberty. The largest class of ascites, or that arising from disease of the kidney, takes place between 20 and 45; the next largest class, or that from disease of the liver or the heart, occurs most frequently from 40 to 60. Both sexes are liable to ascites, and apparently in nearly equal proportions.

Pathology.—Cases of ascites are often examined in which no affection of the peritoneum or of any organ or tissue can be discovered, and consequently it is essentially only a disease of function. More commonly, however, the peritoneum is either chronically or acutely affected, or some viscus is diseased, or some tumor presses on the large vessels, and causes the effusion which constitutes the ascites.

When the peritoneum is chronically affected, it becomes thickened, opaque, and, in some cases, of an aponeurotic whiteness. In general the portions covering the liver or the spleen are much the most thickened and diseased, owing probably to primary disease of those organs having extended to their peritoneal covering; on the contrary, if the peritoneum be acutely inflamed, it is red and injected, and more readily detached from the walls of the abdomen than in health: it may also be tuberculated, or the seat of other disease.

The kidney is the organ most frequently affected when the ascites is secondary: indeed the number of cases of this form of dropsy amount, according to Dr. Wells, to 55 per cent. of the whole number treated, and according to Dr. Christison, to 75 per cent. The kidney is found in this affection in every possible state of disease,—that is, it may be atrophied, hypertrophied, encysted, tuberculated, or cancerous; but in the vast majority of cases it is found in that peculiar state of degenerescence usually termed Bright's kidney, and in every stage incident to that disorder.

The next most frequent concomitant affection is disease of the heart and large blood-vessels, to which it is supposed that at least one-fourth of all the cases of ascites is owing. In these cases the cavities of the heart are often enlarged, and their walls either hypertrophied or atrophied, or else the valves are ossified, or their action otherwise impeded. The aorta also is often pouchy, and its elasticity destroyed by ossific deposit or other affection.

The liver and spleen are the organs next most frequently affected; and they may be found in every possible state and stage of disease. In the former of these instances it is generally supposed that the dropsy is owing to the obliteration of the capillary vessels; looking, however, to the thickened state of the peritoneum covering the liver, it seems that sympathetic irritation of that membrane must at least often contribute to the production of ascites. No satisfactory theory has yet been proposed for ascites resulting from diseased spleen; but looking to the excessive hæmorrhage, which often terminates the life of the patient in these cases, it seems probable that it must in some measure depend on an altered state of the blood.

In general anasarca accompanies ascites, and is an abnormal collection of serum in the cellular tissue of the lower extremities or other part of the body. In these cases the cellular tissue is found in very varied states: in some cases the cells are greatly enlarged, in others obliterated; while the tissue itself, generally thickened, tears most readily in some cases, while in others it is not only greatly thickened, but also greatly indurated. The fluid also which it contains is generally limpid and watery, holding in solution a large portion of albumen, and probably of urea, while in other instances the fluid is viscid and contains lymph.

The quantity of fluid contained in the abdomen varies from a few ounces to many gallons; three to four gallons are by no means unusual, and as much as eighteen gallons are said to have been drawn off at one time by the operation of paracentesis. The quality of this fluid is very various. In colour it is generally green or yellow, in consistency viscid, often containing so much free albumen as to be incapable of flowing through the canula. When treated with nitric acid that substance is thrown down so abundantly as to form a jelly, or a still more solid mass. In other cases it is mixed with lymph; and, in a few instances, contains a large number of hydatids. When the urine is scanty the effused fluid contains urea, and also the usual salts of the blood.

Symptoms.—The symptoms of ascites are extremely well marked, but vary in some degree according to the cause, so that it will be better to give first a general outline of its more prominent features, and afterwards to point out those particular symptoms which denote the cause from which it springs.

In ascites, if the quantity of fluid effused be considerable, the abdomen is distended and shining, with a number of large superficial veins creeping over its surface. From the weight of the abdomen the gait of

Elementary Principles of Medicine.

the patient is upright like a pregnant woman, and he walks wide between the legs from anasarca. In bed he is unable to lie down on account of the fluid in the abdomen gravitating towards the chest and compressing the lungs, so that he is obliged to be assisted by the dropsy-bed. If the anasarca be limited to the lower extremities the upper portion of his person is in general greatly emaciated, and his sharp and pinched features and his withered arms form a striking contrast to his protuberant abdomen and swollen legs. On the contrary, if the anasarca be general, the trunk, the arms, the hands, the eye-lids, and face generally are tumid and swollen to a most unsightly degree. In one case now in St. Thomas's, the features of the patient are lost in the general œdema, while from the pressure of some enlarged glands of the neck those parts of the cheek which are usually red are purple, and the tip of the nose, instead of being white, is one patch of ecchymosed venous blood. The urine is often defective in quantity, but is sometimes natural and sometimes in excess. The skin is dry and the patient thirsty; his appetite greatly impaired, and his spirits greatly depressed.

The progress of the disease is seldom accompanied by any severe constitutional symptoms; but at length the legs and scrotum become greatly distended, and often inflame, so that the patient sometimes ultimately falls from gangrene of these parts. Again, bronchitis may take place; or, the urine becoming nearly suppressed, effusion may occur in the chest, or in the head, and the patient die comatose, or of hydrothorax.

The favourable circumstances are, the secretion of urine being re-established and becoming natural, the subsidence of the anasarca and of the ascites, and then a gradual return to health.

The presence of water in the abdomen is determined by percussion of that cavity; and the best mode is to place one hand on the abdomen, and to give a sharp but gentle tap on the opposite side with the fingers of the other, when, if water be present, a fluctuation will be felt; when, however, the quantity of fluid is small the fluctuation is best felt by percussing the side of the abdomen, or from before backwards. The existence of fluid in the cellular tissue of the trunk or extremities is determined by the finger leaving a mark or "pit;" the water, being inelastic, is displaced, and thereby graviting back the part does not recover its original form and fulness for some seconds.

The ascites may form suddenly and the patient be distended in a few hours, or it may take weeks or months for the fluid to accumulate. The duration of the disease is very various. If the effusion be general, the patient's life may terminate in a few days; but more commonly the affection is chronic, and the patient survives many weeks or months. Such are the more general laws of ascites; but it is now necessary to pass to those particular forms which constitute its varieties.

Ascites sometimes results from the large effusion of serum which is poured out occasionally in acute forms of *Peritonitis*. In this case the abdomen is extrêmely painful, the pain much increased on pressure, and the pulse quick. The patient very generally recovers from this affection; but if he falls death usually occurs within a very few weeks from the first attack. Ascites sometimes results from chronic peritonitis; and now, although the patient sometimes suffers much pain, more commonly this symptom is wanting, or only occurs in occasional paroxysms; so that he appears ultimately to fall from the conjoint effects of the anasarca and of the ascites. The urine is scanty, but for the most part free from albumen in both these forms of disease.

A *diseased heart*, or diseased state of the aorta, is often the primary cause of ascites, and in this case also the urine seldom contains any albumen. The heart's *bruit*, its impulsion, together with the character of the pulse, will in general give the particular lesion under which the party labours. This dropsy may first show itself either by effusion into the abdomen, or else into the cellular tissue of the lower extremities, causing anasarca. When effusion has taken place, it is remarkable that the action of the heart becomes more regular, its impulse more natural, the pulse slower and steadier, while perhaps the *bruit* disappears altogether. This apparent amendment, however, is fallacious, for the dropsical symptoms increase, effusion takes place first into one cavity and then into another, so that the patient seldom long survives this fatal symptom. The urine in this form of dropsy is generally deep in colour, small in quantity, and of a healthy density.

When ascites arises from a *diseased liver*, that viscus is generally enlarged, especially the left lobe; but it is, in some instances, smaller than usual. The ascites in this case has no new feature, except that the patient may or may not be jaundiced. In the former case all the fluids effused are of a yellowish or greenish yellow colour. The urine also is loaded with bile, which is generally turned green by the addition of nitric acid; while in a smaller number of cases the bile appears to be in a peculiar state of combination with the urine, so that the acid has now no effect on it; the urine likewise is always small in quantity, much loaded with the usual salts, and of a high density. The bowels are difficult to act upon, and the patient is liable to severe abdominal pains similating chronic peritonitis. The pulse continues throughout the disease for the most part natural, and the patient usually falls into a more or less typhoid state, from which there is no recovery.

In ascites from disease of the *spleen* the urine is also in general healthy, though scanty in quantity. This viscus is uniformly enlarged, and can readily be felt occupying the left hypochondriac region, and thus the cause, though not its exact nature, can be determined; for we have no diagnostic symptoms denoting whether the spleen be simply hypertrophied or in a cancerous or tuberculated state. The early symptoms are similar to what occur in dropsy of the liver; but the termination of the disease, if the patient falls, is singular, or by hæmorrhage from the stomach and bowels, often so profuse as to amount to many pints in a few hours, greatly exhausting the patient, and hastening the fatal catastrophe.

In dropsy from disease of the *kidney* the urine may or may not contain *albumen;* but in the great majority of cases it does so. When albumen is absent, as the chronic forms of diseased kidney are all devoid of pain, we are unable to determine either the seat or the nature of the disease with which it is affected, and the ascites is consequently in general attributed to an affection of the peritoneum, of the liver, or other viscus. When, however, albumen is present, it may arise from mere functional disease of the kidney; from its being beset with hydatid cysts; or from its being indurated, or the seat of other structural disease; but by far the most common cause, however, of albuminous urine is that peculiar degenerescence called Bright's or the granular kidney. This term embraces many different

stages or chronic forms of disease; but as these are all devoid of pain or other local symptoms, the particular form of disease is a mere matter of calculation deduced from pathological investigations. The dropsies which follow this latter morbid state of the kidney are frequent, are accompanied by albuminous urine, and follow many singular laws.

In dropsy arising from granular kidney, the lower extremities generally first become anasarcous; and this is so constantly the case that the disease is usually termed the "leg dropsy;" and, after this, effusion usually takes place into the cavity of the abdomen, and subsequently perhaps into that of the chest and head. The anasarca, however, is not confined to the lower extremities, but the whole cellular tissue of the body is often infiltrated with serous effusion. Thus, the trunk, the chest, the arms and hands, as also the face and neck, are often wonderfully swollen and distended in this extraordinary and fatal disease. The effusion having taken place, Dr. Christison divides the disease into three stages, principally deduced from the state of the urine. It must be admitted, however, that these stages are not always well marked, and that much difference of opinion exists as to the phenomena of the latter stage.

In the first stage, the quantity of urine passed is sometimes natural; in a few instances it is increased; but far more generally it is diminished. Most usually in colour it differs little from that of health; but it is turbid from being mixed perhaps with a small quantity of mucus. A sediment, too, sometimes forms in this stage, which is either lithic acid, or the lithate of ammonia, or bubbles form as with soap and water. In a smaller number of cases the urine is of a blood-red tint, occasionally mingled with clots, and sometimes with pure blood, which afterwards coagulates.

By far the most remarkable property of the urine, however, in this as in every other stage, is its coagulability under the action of heat or acids, showing the presence of albumen. The quantity of albumen varies greatly, sometimes the addition of the acid merely rendering the urine opaline, while at other times the albumen is precipitated in heavy white flakes, which occupy from one-third to three-fourths of the whole space of the urine tested. Still, though the apparent volume of the albumen is great, yet its weight is trifling, for 10 parts by weight in 1000 parts of urine will render it almost a thin uniform pulp when heated. The greatest quantity Dr. Christison has met with is 27 parts in 1000; and in this case the urine was converted into a solid gelatinous mass, from which no fluid issued when the tube was turned upside down.

Besides containing albumen, the urine also deviates from the healthy standard in containing a less quantity of its usual solid ingredients; the daily discharge of solid matter being from one-sixth to one-fourth less than the healthy average. The loss of weight is chiefly in the urea, but the salts are likewise diminished. The urea is not only deficient in quantity, but is supposed to be imperfectly formed, the urine having a great tendency to undergo decomposition. Another remarkable property of this urine is, that although loaded with albumen, its specific gravity is reduced; or supposing the healthy average to vary from 1020 to 1030, it now varies from 1016 to 1025. The pathognomic characters of the urine in the incipient stage of granular disorganization of the kidney are, then, a moderate reduction of density, an albuminous impregnation, and a material diminution of the solid ingredients.

As the disease advances, the second stage forms, and the quantity of urine is now often little below the standard of health, and in most instances even much exceeds it, the patient passing sometimes from 100 to 130 ounces daily. Its colour is generally pale, and its specific gravity much reduced, sinking to 1016, 1012, 1008, and even as low as 1004. Albumen is still thrown down by the usual tests, and if the quantity of urine is small, that substance is greatly abundant and flaky; when, however, the quantity is increased, the proportion of albumen seems diminished, either the now greatly impoverished state of the blood affording a less amount of it, or else that it is diluted by the greater amount of watery urine. The other solid contents are also reduced, or from 67·7 parts in 1000 to about 24 parts in 1000.

In the third stage, according to the observation of most writers, the quantity of urine decreases, and the proportionate quantity of albumen is increased till at last the urine is in some cases almost altogether suppressed, or else nearly pure blood is passed; and there are even cases in which the urine contained in the bladder has been found coagulated after death. Dr. Christison, however, states as the result of his practice, that the albumen diminishes in this stage.

Besides the alterations in the urine, changes not less remarkable take place in the condition of the blood. The density of this fluid in health is between 1029 and 1031; but in granular degenerescence of the kidney it is often as low as 1020, while the solid contents are reduced from 100 or 102 in 1000 to 68, 64, and even to 61 parts in 1000. This reduction equally extends to the albumen as well as to the saline ingredients, so that the serum is often greatly deficient in that substance, and coagulates but loosely when heated.

Another not less remarkable departure from the healthy constitution of the blood is the presence of a large quantity of urea in the circulating fluid. This fact was first hinted at by Dr. Bostock, and has been subsequently established by Dr. Christison, who affirms that when the urea is reduced by disease to one-third its natural amount in the urine, it is always to be detected in the blood. Again, while the other constituents of the blood are diminished, the fibrine is usually increased in this remarkable disease, or instead of 25 to 52 parts in 10,000, the proportion in health, it now varies from 32 to 80 parts in 10,000. This augmentation is supposed to depend on the degree of constitutional re-action caused by the local inflammation under which the patient so often labours. Dr. Christison, from whom these details are borrowed, states that the hæmatosine or colouring matter of the blood is little affected, and also that in advanced stages of the disease the density and solid contents of the serum, which have been shown to be invariably reduced at the beginning of this affection, gradually return to the healthy standard, and even exceed it. This, however, can be by no means constantly the case.

The extraordinary manner in which the blood becomes impoverished and robbed each successive day of a portion of its most nutritive ingredients, must prepare us to expect many diseases both of function and of structure in the course of this affection, and there are few organs or tissues that do not suffer. The most frequent lesions are perhaps those of the alimentary canal. Impaired function of the stomach is frequent in every disease of the kidneys; but in this affection it is often so excessive as to constitute a disease more distressing even than the original complaint. In some cases the stomach suffers from simple dyspepsia, in others from sickness with oc-

casional vomiting, while in others everything is returned. This chronic vomiting is most frequent in the second stage of the disease.

Another very common symptom in albuminous urine dropsy is diarrhœa. This affection generally arises from irritability of the coats of the intestines, but it occasionally terminates in ulceration of the bowels. It is frequently but not always attended with pain. The evacuations are loose, but present nothing remarkable, except being occasionally intermixed with portions of shred-like matters. This diarrhœa is sometimes mild, but more often severe, and greatly exhausts the patient without reducing the dropsy. This affection is common in every stage of the disease.

Besides functional or structural disease of the mucous membrane of the alimentary canal, the peritoneum is liable to be inflamed, and the patient to be thus prematurely cut off. Dr. Bright found traces of inflammation of this membrane in 45 cases in 100, and in 12 or 13 it was extremely well marked. The symptoms in this case are of course great pain of the abdomen, with a rapid and small pulse.

The lesions of the organs contained in the chest are as frequent as those of the abdomen. Bronchitis with purulent secretion is extremely frequent, and is always a complication indicating much danger. In some instances it is associated with emphysema of the lung, producing urgent dyspnœa. The substance of the lung, however, is seldom inflamed, Dr. Bright having found only 5 cases in 100 in which there were any traces of recent or of old pneumonia; but œdema of the lung is frequent, it having occurred 31 times out of the 100 cases. Apoplexy of the lung has also been met with.

The pleura is, however, of all the tissues of the respiratory organs, that which is the most commonly affected, it being found more or less diseased in 3 cases out of 4; or in 40 cases there were old adhesions, in 16 cases evident signs of recent inflamation, while in 41 cases there was water effused into the chest.

The heart has been found diseased in 69 cases out of 100, and the lesions have consisted chiefly of hypertrophy, with or without valvular disease. In 52 cases of hypertrophy, chiefly of the left ventricle, no valvular disease could be detected, but in 34 of these the aorta was more or less diseased. When the valves have been found diseased, they have been for the most part those of the left side of the heart, or the aortic and mitral valves. When disease of the heart is conjoined with granular kidney, the patient often suffers from severe and fatal hæmorrhage from the bowels.

Solon says, of all the influences which granular kidney exercises over the œconomy, the gravest is that which it exerts over the brain. The first symptom of the affection of this organ is long-continued and severe headache, then obstinate somnolescence, and lastly coma; and 8 cases out of 10 are supposed to terminate fatally, either by convulsions, coma, or by serous apoplexy. But although these symptoms are formidable, the lesions are limited to the membranes, and these are sometimes absent, for in 48 cases only out of 100 Dr. Bright found the arachnoid diseased; or in 13 cases it was opaque, in 29 serum was effused into its cavity, and in 6 there was water in the ventricles. The substance of the brain has been for the most part found healthy.

It is singular that the liver, spleen, and pancreas have a great immunity from disease in this form of dropsy, a fact the more remarkable as the patients are often habitually intemperate. The instances of confirmed disease of structure of these parts were so few, that they did not amount to more than 18 in 100 cases, while in 32 the deviation from the natural structure was exceedingly slight, little more than a mottled state caused by an irregular distribution of blood throughout the texture, a condition frequently observed when the circulation through the chest is obstructed. Such are the peculiar symptoms which the different genera of ascites present.

Diagnosis.—Ascites is readily distinguished in the male from every other intumescence of the abdomen by the fluctuation on percussion. In the female it can only be confounded with ovarian dropsy.

Prognosis.—The prognosis in anasarca in young persons not labouring under any organic disease is always favourable. If, however, it be consecutive to organic disease, a fatal termination is ultimately to be feared.

Ascites arising from indeterminate causes is often recovered from, but no case is free from danger, the peritoneum often taking on the character of a cyst, and resisting the action of all medicines.

Ascites depending on moderate inflammation of the peritoneum is often recovered from, and especially if the inflammation depends on the action of the paludal poison.

Ascites with albuminous urine, arising from mere functional disorder of the kidney, is generally recovered from; but if the structure of the kidney be impaired, the disease is always grave and generally fatal. In a few cases, however, the disease subsides, and the patient continues well for two, three, or four years, when he generally relapses and dies.

Ascites from disordered function of the heart is often recovered from; but if it depends on diseased structure either of the heart or large vessels, some temporary amendment may take place, but the patient quickly relapses and finally sinks.

Ascites depending on diseased structure of the liver or of the spleen is rarely recovered from unless the primary disease be cured.

Treatment.—The ancients witnessed so few recoveries from dropsy, that they looked on the restoration of the patient as an accident, or as a special blessing from heaven, rather than the result of physical causes. The treatment of ascites in the present day, it must be admitted, is often unsuccessful; still it may be affirmed that one-half the patients are cured, which is abundantly sufficient to overthrow the opinions of the earlier schools. The treatment of any given case is often, however, of great difficulty; for the remedy which will cure one patient has frequently failed with another, and apparently under exactly the same circumstances. All that can be done, therefore, is to lay down some general rules, leaving their particular application to the discretion of the practitioner.

When ascites occurs without any obvious cause, and without albumen in the urine, the best medicine is unquestionably the bitartrate of potash, first introduced by Vicenti Manghini. This valuable remedy may be given either in divided doses, as ʒ j. three times a day, or every six hours, or else in one large dose, as half an ounce, strengthened, if the patient's bowels be confined, with ten to fifteen grains of jalap. When the smaller doses are used, it is often exceedingly useful to add ten grains of the citrate or tartrate of iron to each dose. If these remedies should fail, a grain of elaterium every night or every other night may be tried.

There is one form of ascites, without any obvious cause, in which the accompanying anasarca is caused by effusion of serum into the intermuscular tissue, and be-

neath the fascia of the legs, rendering them extremely hard and tense. Under these circumstances squills appear to be the best remedy, and by giving five to eight grains of the pulvis scillæ three times a day, the dropsy is always relieved and the patient sometimes recovered. If the stomach be irritable, half a grain of opium should be added to each dose, so that it may be retained.

Should the ascites arise from simple inflammation of the peritoneum, this form of dropsy in general yields to leeches and fomentations to the abdomen, together with the sulphate of magnesia ʒ j. c. tinct. hyoscyami ♏ xv. every six hours. If, however, the case be severe, some mercury may be necessary, as the pil. hydrargyri, or moderate doses of the chloride of mercury.

When the inflammation depends on a morbid poison, the treatment varies according to the nature of that poison. Thus, if it be the result of the paludal poison, preparations of mercury are essential, and the ascites is cured as soon as the mouth is affected. On the contrary, should the ascites or anasarca arise from the poison of scarlet fever, it is in general necessary to bleed the patient. The quantity of blood taken should be proportioned to the age of the patient: a child of six years of age may lose from four to six ounces, an adult ten to sixteen ounces. After this, almost any active purgative will effect the cure,—as the bitartrate of potash, the sulphate of soda or magnesia, or repeated doses of rhubarb or jalap. In many cases, however, it is necessary to combine the purgative with some mild tonic, as the tartrate of iron, or with salicine.

When the ascites arises from disease of the heart, the kidney being sound, and the urine free from albumen, the treatment must have reference to the nature of that disease. If the valves of the heart are ossified or otherwise diseased, the patient, though he cannot recover, may be greatly relieved, and mist. camphor. ℥ iss. c. sp. ætheris nitrici ʒ j. c. tinct. hyoscyami ♏ xv. c. tinct. digitalis, ♏ xv. c. magnesiæ sulphatis, ʒ j. ter die vel 6tis horis, this mixture often greatly reducing the dropsy. When the stomach will bear it, the tinct. scillæ ♏ x. to ♏ xx. with a drachm of the acetate of potash, has occasionally succeeded. Small doses of elaterium, as $\frac{1}{8}$ to $\frac{1}{4}$ of a grain ter die, is a medicine that is also sometimes useful. Blisters to the cardiac region give relief; but it should be remembered that heart cases bear bleeding badly, and that operation should be avoided except in one case, or when blood is expectorated. If blood, however, appears in the sputa, ten to sixteen ounces may be taken not only without injury but with great benefit. In those cases in which the valves still continue healthy, but in which the heart is enlarged and hypertrophied, and has acquired a rolling irregular action, the dried seeds of iberis amara are the best remedy. The dose is from iij. to v. grains three times a day.

The ascites may be caused by disease of the liver; and should that organ be merely inflamed or hypertrophied, without other alterations of structure, the dropsy is often cured. The treatment is by bleeding, and the neutral salts, as the sulphates of magnesia or of soda, or, should they fail, by moderate doses of calomel. When, however, its structure is otherwise altered, the patient is seldom cured; but the disease may still be alleviated and life prolonged by mercury pushed often so as to affect the mouth. In this form of ascites the patient suffers greatly from abdominal pains, which can only be relieved by hot bottles or fomentations. In these cases, also, the bowels are often greatly constipated, and require the most powerful drastic purgatives, as the black draught, castor or croton oil, or elaterium. In this form of dropsy, however, the peritoneum partakes more of a cyst than in most of the others; the water is therefore seldom reduced, and the patient generally requires the last imperfect resource of the art, or tapping.

Elementary Principles of Medicine.

Ascites depending on enlarged spleen is also difficult of cure. If the spleen be simply hypertrophied, the bromide of potash, in doses of five to eight grains three times a day, is perhaps the most efficient remedy, and after that the iodide of potassium. The patient, however, often falls from hæmorrhage after all the more prominent symptoms have been relieved.

The dropsy which often occurs in young chlorotic women, in which the urine *contains albumen*, the kidney, being healthy in structure though disordered in function, is generally cured; and the remedies which are most efficient are salicine gr. x. ter die, or else the bitartrate of potash, ʒ j. ter die. The former is a mild tonic, has considerable power in restoring menstruation, and likewise acts on the bladder. The cream of tartar also is an excellent remedy, both as a diuretic and as a purgative in these cases.

Ascites, however, with *albuminous urine*, and depending on the *granular* kidney, as it is the most common form of dropsy so it is the most intractable. The difficulty of the treatment is also enhanced by the fact that the remedy which succeeds with one patient will often entirely fail in another exactly similar case, while a large class of these patients are not beneficially influenced by any treatment yet proposed. The most general rules we can lay down are as follows.

Many practitioners, from the number of secondary inflammations which follow in the train of albuminous dropsy, have considered this disease to be inflammatory, have termed it '*inflammatory dropsy*,' and consequently have recommended bleeding as the cardinal point on which the treatment turns. It should be remembered, however, that inflammation is as assuredly produced by defect as well as by an excess of nervous excitement. In albuminous urine dropsy, therefore, the blood is impoverished by the loss of a considerable portion of its albumen, and consequently it seems to follow that the inflammation is of an asthenic character, and, so far from being controlled by bleeding, is likely to be rendered more intense and fatal by that operation. The profession, however, is divided on the subject: Dr. Blackall, Dr. Christison, and Dr. Elliotson recommend bleeding: Dr. Bright uses the lancet with extreme caution, while many able practitioners forego its use altogether. In general bleeding does not diminish the quantity of serum in the urine, while it enfeebles the patient, even when young and of considerable powers of constitution. It may not do all the mischief that might have been expected from it, but it certainly does not do the good that has been attributed to it.

With respect to remedies, by far the greater number that recover are cured by the bitartrate of potash, or by similar remedies, as the binoxalate of potash, or the oxalic acid. The irritable state of the bowels in this disease hardly allows large doses of these medicines to be employed; and a drachm of the bitartrate of potash three times a day, or ten grains of the binoxalate of potash, or of oxalic acid, also exhibited the same number of times in the day, are as large doses as the patients will generally bear, and even in many of these cases a grain of opium is necessary at night to enable them to continue their use. The action of these diuretics is often

much assisted by some vegetable or mineral tonic, as the ferrum tartarizatum, of which ten grains may be given three times a day, or else the salicine, of which ten grains also may be given at similar intervals.

When the superacid salts fail, the patient is not to be abandoned, for by some inexplicable affinity or susceptibility, other remedies will occasionally take up the disease. Thus one patient, in whom the bitartrate of potash failed, was recovered by salicine, gr. x. ter die. Another, in whom both the bitartrate and salicine had failed, was cured by the dried seeds of the iberis amara, gr. iij. to v. ter die;—others again are relieved by squills; and others, perhaps, by the bryony root. When the bones have been diseased, the iodide of potassium has cured the disease; while in affections of the heart, digitalis has occasionally emptied out the patient. These are isolated instances of success, still they ought to induce us not to abandon the patient unless after trying an extensive series of substances, and happily by perseverance other medicines may be discovered still more beneficial in this fatal disorder.

As yet nothing has been said with respect to mercury, a well-known and powerful agent in the cure of inflammation, and which has been extensively used in albuminous urine dropsy. In some very few instances it may have cured the disease, and in a few more relieved the patient; but in general, if the water has disappeared under its use, this subsidence has been the immediate forerunner of death. Again, the majority of patients are so susceptible of the action of this metal, that they have fallen into most profuse ptyalism, large portions of the jaw have exfoliated, and they have at length sunk, after much deplorable suffering. Among the negantia in this disease then are bleeding and mercury, and to them may be added elaterium and cantharides.

Such is the general treatment of this disease, but there are many particular symptoms in its course which require to be combated, and which we have often in our power to alleviate. *Chronic vomiting* is one of the most distressing concomitants of this affection, and is to be met by the effervescing draught, combined with ♏ j. or ♏ ij. of hydrocyanic acid, or with ♏ iij. to ♏ v. of tinct. opii. One or two drops of creosote out of an aromatic water may also be tried. These are perhaps our most efficient remedies in this complaint; "but the physician," says Dr. Christison, "ought not to be surprised if he finds all these remedies ineffectual." It is this tendency to chronic vomiting which renders the propriety of administering squills so doubtful in this disease.

Diarrhœa is common in this disorder, so that it is almost always necessary to combine the purgative salt with some opiate; and sometimes the bowels are so singularly irritable as to oblige us to abandon all opening medicine, and to prescribe astringents, as kino, catechu, or hæmatoxylum, or else the mistura cretæ composita c. opio, and even pure opium, to the amount of two, three, or four grains a-day: and in addition to this the patient should be supported by small quantities of wine or brandy. Dr. Christison speaks highly of the acetate of lead in these cases; but under any treatment this symptom is dangerous and distressing.

Inflammation of the peritoneum, when combined with albuminous urine dropsy, presents likewise great difficulties in its treatment; for if the patient be bled he is often not relieved, and if that operation be neglected, he most commonly dies. The usual treatment of this symptom is by leeches, fomentations, mercury, and opium.

Inflammation of the pleura presents the same difficulties as peritonitis, every present mode of treatment being most unsatisfactory. Œdema of the lung, or effusion into the cavity of the chest, are also generally fatal occurrences, and without remedy. The bronchitis is perhaps best treated by blisters, anodynes, and small doses of squills. The affections of the heart in this, as in all other forms of dropsy, are exceedingly intractable; but iberis, digitalis, with or without æther, for the patient generally requires support, and also occasional small bleedings, if hæmoptysis should occur, are those remedies which usually give most relief.

In the chronic headache, with which the patient is often troubled, small doses of arsenic, as one-twentieth of a grain three times a day, have several times removed it. When effusion takes place into the cavities of the brain and of the arachnoid, the patient's state, whatever be the modes of treatment employed, is generally hopeless.

The treatment of the various forms of ascites that have been detailed, though often successful, yet is frequently inefficacious, the peritoneum partaking more and more of the properties of a cyst, so that the abdomen becomes greatly distended, anasarca of the legs extends upwards to the thighs and trunk, while the scrotum is distended almost to bursting. Something more then is often necessary to be done to relieve the patient; and we have it in our power to draw off the water by tapping the abdomen, or by scarifying the legs, or by puncturing the scrotum. In making this choice, however, we are surrounded with difficulties; for the operation of paracentesis is not lightly to be hazarded, since it rarely cures the disease in its simplest forms; and when it is connected with disease of the heart, the liver, or the kidney, the relief is but temporary, for in a few hours the patient rapidly fills again, and becomes more distended than before. The operation also diminishes the chances of ultimate recovery; for unless the patient recovers, the peritoneum is rendered greatly more insensible to the action of remedies, while peritonitis may follow, and at once destroy the patient. Still, notwithstanding these adverse chances, the patient's state is often so deplorable, and he so earnestly entreats for the operation, that there are cases in which it is justified.

Scarification of the legs, or puncture of the scrotum, is apparently a much more simple and harmless operation than paracentesis, no vital organ or tissue being immediately injured, while the drain of water is often considerable. These advantages, however, are completely counterbalanced by the very constant occurrence of inflammation, at least in London, after these operations. If the scrotum be punctured, the inflammation usually begins in the skin, extends to the cellular tissue, and at last involves the testicles, and the pain in these cases is not only severe, but amounts to agony. Nor is the patient relieved, except by the supervention of gangrene; and even if gangrene takes place, the skin often survives the death of the cellular tissue, so that the agony is little mitigated, and thus he often dies in horrible torments. Scarification of the leg is also very generally followed by inflammation, also terminating in gangrene; but although the actual suffering in this case is less severe than in the former, still it is often agonizing, irremediable, and accelerates the death of the patient. No law is perhaps better determined in medicine than that of not scarifying, unless in some extreme cases, either the legs or scrotum of a dropsical patient. It has been thought that a minute puncture, as with a needle, would obviate

this difficulty; still, if a puncture be large enough to allow a drop of fluid to escape, the parts over which it flows become irritated by its acridity, and inflammation follows, perhaps as soon and as severe as when a larger opening is made. It has been attempted to explain this phenomenon by affirming that the effused fluid contains urea, and has therefore the properties of urine. This may be probably the case, but it lies without action in the sound cellular tissue, which urine would not do; while urine which flows over the healthy skin leaves little trace behind.

Hydrops Ovarii—Ovarian Dropsy—

Is an effusion of a watery fluid into one or more cysts formed in the ovary, and is a disease known from the earliest antiquity.

Remote Cause.—The remote cause of this form of dropsy is hardly known, so that it probably arises from slight causes acting upon a particular idiosyncrasy. Its more obvious causes are mechanical injuries, as well as all those causes which act upon the uterus, producing menorrhagia or amenorrhœa.

Predisposing Causes.—It is doubtful whether any case is known before puberty; but Franck mentions having seen a young person of thirteen years of age labouring under this disease, and Stard one of fourteen. It sometimes occurs between twenty and twenty-five, but is most common towards the period of the cessation of the menses, and from that period till sixty. It occurs in the unmarried as well as in the married female.

Pathology.—The seat of this disorder is supposed to be the Graafian vesicles, or else the cellular tissue which connects them, or perhaps both. These vesicles, or cells, probably by a process of achromatous inflammation, form cysts, which secrete a fluid like water in much greater abundance than it is absorbed, so that it acts as a distending force, which slowly augments, till at last the cyst or cysts acquire an extraordinary size, containing many gallons. The walls of the cyst are at first transparent; but as the disease advances they become thickened, opaque, and of considerable tenacity, so much so, that in some instances they are cartilaginous, and in others osseous. The size of these cysts is often so great that they rise above the pelvis, thrust the liver and spleen into the chest, and at length fill the whole abdomen.

The number of these cysts is very various, but most commonly there are from three to six, and even many more. They are very uniformly of different magnitudes, and in general the largest occupies the anterior portion of the ovary. Examined externally, the tumor is irregular and knobbled from the projection of the smaller cysts. When the disease is advanced, nothing is more variable than the nature and quantity of fluid these cysts contain. Often in the same ovary there are as many different fluids as there are cysts; one being filled with serum; another with a fluid like thin honey and water; a third with pus; and a fourth, perhaps, with a fluid like chocolate grounds, or blood, more or less modified. It is the great density of many of these fluids which causes the tumor often to feel hard and to be void of fluctuation, and consequently sometimes to be mistaken for fungus hæmatodes, or other solid substance.

The quantity of fluid which these cysts contain is as various as its quality. At first the cyst is small, and its contents hardly exceed a drachm; but in advanced stages of the disease the cyst has been known to hold 120 and even 140 pints, much exceeding, perhaps, the entire weight of the woman's whole body.

On examining the body after death, we usually find some fluid effused into the cavity of the abdomen; the cyst also often adherent to the walls of the abdomen, and the intestines glued together in consequence of the inflammation caused by the great pressure. If the patient has fallen after tapping, the inner walls of the cyst are often actively and extensively inflamed, and perhaps filled with pus. It is seldom that both ovaries are found diseased, and in a very few instances the cyst has been found pediculated, or else formed in the Fallopian tube.

Symptoms.—The early stage of ovarian dropsy is often little marked, and the disease silently forms without any symptom, or only some slight uneasiness in the ovarian region, and in a very few instances by some occasional attacks of severe abdominal pain, probably from the setting up of adhesive inflammation.

In this incipient stage the tumor is often long stationary, but at length it rises above the pubes, and then it may rapidly or slowly enlarge, till it fills the whole abdomen. The general health is also rarely impaired till the tumor attains an inconvenient size, and presses upon and displaces the surrounding viscera; under these circumstances the urine, which was passed naturally as to quantity and as to time, is either long retained or voided frequently. Pain also is felt in the loins and down the thighs. The bowels are costive, and the catamenia either irregular or suppressed, and, from the general debility, the patient towards the close of the disease becomes hysterical. Besides these local symptoms, the legs become anasarcous, and ascites is at length added to the original affection. Under this general impairment of the functions of the different viscera, the health of the patient sinks, she is unable to lie down from her unwieldly size, the powers of life are exhausted, and death puts a period to most protracted suffering.

The whole duration of this affection is very various, or from a few months to two, three, or four years.

Diagnosis.—This disease is to be distinguished from hydrops uteri only by an examination, and from encysted dropsy of the liver, or other encysted dropsy of the abdomen, only by its situation. The greatest difficulty, however, is to distinguish it from fungus hæmatodes of the mesentery; for when the fluid in the ovary is of much density there is no fluctuation, and the sensation it gives is that of a solid body. The fungoid tumor, however, generally forms higher up and more in the centre of the abdomen, and is thus distinguished by its locality.

Prognosis.—A very few cases have been supposed to have recovered from ovarian dropsy; such instances, however, are only exceptions to the general fatality of the disease, and consequently the prognosis is uniformly most unfavourable.

Treatment.—The profession generally are perhaps more agreed upon the entire nullity of all remedies in the cure of ovarian dropsy than perhaps on any other fact in practical medicine, and are almost universally of opinion, with Dr. John Hunter, that the patient will have the greatest chance of living longest who does the least to get rid of it. The medical treatment is, therefore, almost limited to obviating symptoms, regulating the bowels, and increasing the flow of urine so as to keep down the anasarca and ascites which are so commonly present.

As the medical treatment of ovarian dropsy is at present only palliative, paracentesis in some instances becomes imperative, owing to the urgency of the symp-

Elementary Principles of Medicine.

toms. This operation, however, should be delayed as long as possible, from the multilocular nature of the cyst; for supposing one cyst to be emptied, there are in general several others quite out of the reach of the trocar. It should also be delayed from the danger of inducing inflammation in the cyst itself, and thus distroying the patient with tenfold suffering. Under the most favourable circumstances, also, the fluid soon collects again, and the patient is thus obliged to submit to a frequent repetition of the operation. One patient mentioned by Morand underwent 30 operations in 25 years, and had drawn off 6600 lb., or perhaps 60 times her own weight. Another instance, a Mrs. Mumford was tapped 55 times in four years.

It has been proposed, after tapping, to effect a radical cure by laying open the tumor, or by keeping a canula inserted in it; but as very few cases are mentioned as having recovered by this practice, the multilocular nature of these cysts, and the danger of inflammation, must ever prevent the humane physician from recommending it.

Besides tapping the cyst, the extirpation of the entire ovary has been proposed, and, as it appears, has been successfully performed by L'Aumonier of Rouen, and by Drs. Smith and Macdowal of the United States. The operation proposed has been an incision through the walls of the abdomen, and then raising the sac to eradicate it by ligature or other means. This practice has been repeated in this and other countries by Blundell, Lizars, Dieffenbach, and others, but, except in one instance, it has entirely failed. In three cases the patients died of the operation, and in a fourth the surgeon did not proceed with the operation, finding the tumor adherent on all sides. Mr. Walne, however, has very recently performed this bold operation, and with success, in two cases. Another mode of curing the patient is by acupuncturation, which M. Bonfils recommends, and states that it has in some instances been successful. This operation is entitled to a more extended trial than has yet been given it, for the generally multilocular nature of these tumors renders it hardly possible that tapping should be in any instance ultimately successful.

When these methods have either been rejected or failed, a last mode of relieving the patient is by puncturing the legs, which are often greatly swollen, rendering it impossible to flex them. The operation in this case is liable to even greater objection than in ascites; for, besides the punctures very commonly inflaming, the relief by this method must be very trifling, while the chance of a cure is entirely hopeless.

The treatment of ovarian dropsy presenting so few chances of success, it is grateful to be able to add, that in a very few cases a spontaneous cure has taken place. Dr. Baillie mentions an instance of its spontaneous disappearance after it had existed three years, the patient remaining subsequently in good health. Instances have occurred to Dr. Elliotson, to Dr. Montgomery, to Dr. Copland, and others, of the tumor having formed adhesions to the intestines or to the vagina, and rupturing, and thus discharging its contents into those cavities; and Dr. Seymour mentions a case in which the tumor burst into both canals, and recovery took place. The ovary has sometimes also formed adhesions to the abdominal parietes, and has burst externally, and the patient recovered. Dr. Blundell has, in his published lectures, given a case of rupture into the cavity of the abdomen, and of the patient being restored by absorption of the effused fluid.

Dropsy of the Fallopian Tube.—A cyst sometimes forms in the fold of the ligament, either near the uterus, or near the ovarium, or near the fimbriated extremity of the tube. This disease has been described by Drs. Baillie and Monro. The cyst thus formed is quite as large as that of the ovarium, Cypriani having found one that contained 150 pints, and Hardie another, only something less, or 140 pints of fluid. No distinction can be made either as to symptoms, course, causes, or treatment, between this disease and ovarian dropsy.

Hydrometra—Dropsy of the Uterus.—This disease is of very rare occurrence, and will be better illustrated by a case than by any general description. The following instance is related by Dr. A. T. Thompson, in the *Medico-Chir. Transact.*, vol. xxiii. p. 170.

Mary Rae, at 65, the mother of several children, was admitted into the infirmary in Dec. 1823. She appeared as large as if six months gone with child. It was suspected she was labouring under a diseased ovarium, and an indistinct fluctuation was perceptible in the tumor. There was, however, a greater derangement of the system than usually attends dropsy of the ovarium, as loss of appetite, considerable nausea, furred tongue, quick and feeble pulse, the bowels irregular, and the urine scanty and high-coloured. She died in March, 1824, after amputation of the leg, which operation was performed in consequence of a dry gangrene which had attacked the limb. On dissection the tumor was ascertained to be the uterus greatly enlarged and filled with fluid. It was partially sphacelated on its peritoneal covering at the upper portion of the fundus. On making an incision into it, eight measured quarts of a dark-coloured fluid, which coagulated slightly when heated in a spoon over the flame of a candle, issued from it. The internal surface of the organ was not more irregular nor more spongy than in its natural state, but none of the orifices could be found, for even the os uteri was, interiorly, as completely obliterated as if it had never existed; and although its situation could be traced in the vagina, yet even there it was very faintly marked. In this case the bladder was so stretched as to extend to within an inch of the umbilicus, and must have been perforated by the trocar had any attempt been made to perform the operation of paracentesis.

CLASS II.

OF DISEASES OF STRUCTURE.

However fertile a source of illness and of painful suffering the large class of the Neuroses may be, still, of the 340,000 to 350,000 deaths which annually take place in England and Wales, there can be no doubt that upwards of 300,000 are caused, either primarily or secondarily, by diseases of structure, including those produced by the class of morbid poisons. The diseases of structure are, therefore, of vast importance, so much so that many pathologists have considered them as constituting the whole body of medicine. It is proposed now to divide them into four great divisions; the 1st embracing Inflammations having no specific character, also Malaxoma, Scleroma, Atrophia, and Hypertrophia; the 2nd, Tuberculoma; the 3rd, Carcinoma; and the 4th, Melanoma.

It is also proposed to give the general laws of inflammation, of the formation of cysts, of hypertrophy and of atrophy under one head, in order not to break this short treatise into too many parts.

ORDER I.—OF INFLAMMATION.

Nature repairs the injuries of organized substances in two different ways, or by reproduction and by inflammation. In the vegetable kingdom and in the lower classes of animals the power of reproduction is considerable, a part sometimes reproducing the whole vegetable, or the whole animal; but in man this power is extremely limited, or to the hair, the nails, and the cuticle; for an eye destroyed, or a leg amputated, is never reproduced, the wounds thus occasioned being healed by inflammation. Every part, therefore, or nearly so, being liable to injury, is provided with a *power* of inflammation, and on this property the surgeon relies for reuniting the tendon he divides, for obliterating the artery he ties, and for healing the wound he makes. This power of inflammation, however, is destructive as well as preservative, and is liable to be excited by many other causes than mechanical injuries, or by the numerous class of morbid poisons, by intemperance, the play of the passions, atmospheric vicissitudes, and other circumstances. Inflammation, consequently, has many causes, is of very frequent occurrence, and as it affects every organ and every tissue of the body, is of such extent as to form one of the most prominent features in medicine, and opens a wide field of study and of practice to the physician.

Of the essential conditions of inflammation we know nothing; for we are no more able to assign the reason why a part should secrete lymph, or serum, or pus, than we are why the stomach digests or the liver secretes bile. All we are able to do is to determine the conditions necessary to the existence of this power, and to determine and to generalize its phenomena.

The conditions necessary to the existence of inflammation are one of two things, or else both conjoined, namely, a morbid action or condition of the nerves of the part, and also a morbid state of the fluids. Majendie has shown a morbid state of the nerves will produce inflammation, for he divided the fifth pair of nerves high up in the cranium, when the eye of that side, supplied by a branch of that nerve, inflamed and was destroyed. Again, if, instead of dividing the nerve, we make pressure on it, as by passing a ligature round a part, inflammation still takes place, the part separates into two, and the ligature comes away. Also, if from any cause the spinal cord be diseased, so that the nervous influence of the brain is interrupted and prevented reaching the lower portions of the body, the patient very constantly dies of inflammation of some part below the point of obstruction. It is plain, therefore, that a morbid state of the nerves is one cause of inflammation.

It is equally certain that a morbid state of the fluids will cause inflammation; for if we inject any putrid substance into the veins of an animal, the animal dies of inflammation of the lungs, or bowels, or other part; or if there be any other poison which produces inflammation, as arsenic, let it be injected into the veins of an animal, and it dies of inflammation of those parts for which the poison has an affinity. Majendie has likewise shown that a mere alteration in the proportions of the blood, as the lowering of its quality, is a cause of inflammation. Thus, he took blood from a dog, and having removed the fibrine, re-injected the serum into its veins, when the animal died of pneumonia, so complete that its lung having been laid by the side of one taken from a person that had died of influenza, their pathological states could not be distinguished from each other. Also the same physiologist found, on feeding animals on sugar, that the impoverishment of the blood thus produced was first manifested by inflammation and loss of its eyes. It is proved, therefore, that not only a morbid state of the nerves, but also a morbid state of the fluids, are conditions which, taken separately or together, often determine inflammation. The worst inflammations are those perhaps in which a morbid state of both exists. As a corollary from what has been stated, it may be affirmed, if inflammation is often of a sthenic character, and arises from a too powerful nervous re-action, that it perhaps more commonly arises from debilitating causes, and is of an asthenic character.

The diseased states resulting from inflammation of course will be found in the body of this portion of our subject. The generalization, however, of the phenomena of any science, and a statement of its more general laws, are the first steps towards understanding it. Celsus was the first who attempted to define inflammation, and he affirms a part to be inflamed when it is the seat of heat, of pain, of swelling, and of redness. But this definition appears to exclude much disease that can only result from inflammation; the brain, for instance, is often softened or hardened, or, as we believe, inflamed, and yet no redness is visible. A tooth is often destroyed by caries, and yet there is no swelling; the bowels are often ulcerated, and yet there is no pain. And Mr. Hunter has shown that the heat of an inflamed part never rises above the temperature of the blood in the heart, so that the heat of the abdominal and pectoral viscera when inflamed is not greater than that of a healthy part.

The definition of Celsus being inapplicable to some large classes of inflammation, it becomes a matter of consideration whether certain products, as serum, lymph, or pus, and also certain given states of parts, as ulceration, softening, induration, thinning and thickening of parts, would not afford a better criterion of inflammation than the abstraction of the great pathologist. If this view of the subject be admitted it would necessarily lead to a division of inflammation into *chromatous* inflammations and into *achromatous* inflammations, or into red inflammations and into colourless inflammations. Of the existence of the former there can be no doubt; and as a general principle the definition of Celsus well describes them, but the latter have no less a real existence. Thus we often open a patient that has died of phthisis and find the intestine ulcerated; but so far from being redder, it is paler than natural, and so far from being thickened, it is thinner than usual. We often find the cartilages of the joints ulcerated, and yet not a trace of a red vessel. In cases of bronchitis, with purulent expectoration, if the lung be washed so as to remove the morbid product, the most minute anatomist is unable to determine whether the parts during life were in a state of health or disease. Take the arterial system, and how often do we find the aorta thickened and thinned, softened and indurated, ulcerated and its elasticity entirely destroyed, and yet not a red vessel to be seen; neither has the patient complained of the slightest sensation of pain, or any feeling of heat in the part during life. A large abscess also may form in the brain or cellular tissue, or pus may be effused into the cavity of the abdomen, and without any appearance of redness or having been preceded by any suffering.

There is no question, therefore, of the existence of achromatous inflammation, and this perhaps without any essential difference in the condition of the parts in either form of inflammation; for it seems determined, by the microscopic observations of Müller and others, that all vessels, however minute, carry red blood, but that those which admit one or at most two rows of red globules appear colourless to the unassisted eye. Whether, therefore, the inflammation be red or colourless, the same elements of the blood, though not in the same proportions, are employed in its development. If the division of chromatous and achromatous inflammations be established, a more correct definition of inflammation would be, that it is a state of parts in which the vital affinities are altered, giving rise to certain products, or states of parts: as the effusion of lymph, serum, or pus; or to ulceration, gangrene, thickening and thinning of tissues, &c.

Of Chromatous or Red Inflammations.

Chromatous or red inflammation has many varieties as to kind. Thus we have Simple inflammation, Specific inflammation, Rheumatic inflammation, and many persons speak of a Scrofulous inflammation. These varieties differ in their causes, course, seat, and results, rather than in their phenomena, which it will be necessary now to present in a generalized form to the reader.

Chromatous inflammations, of whatever kind, may be acute or chronic, and have many degrees of intensity, denominated chiefly from their terminations, which are by resolution, by effusion of serum, lymph, or pus, or else by ulceration, gangrene, or mortification; and hence they are termed

Inflammatio diffusa,	Inflammatio suppurativa,
Inflammatio serosa,	Inflammatio ulcerativa,
Inflammatio adhesiva,	Inflammatio gangrænosa.

The order in which these different forms or intensities of inflammation have been named is the order of their intensity in some tissues, but by no means in all of them. In the serous membranes, for example, the progression is correct: the diffuse inflammation being less violent in degree than the serous, the serous than the adhesive, and the adhesive than the suppurative, and so on. But in mucous membranes this order is often inverted, for it is well known that lymph effused from the mucous membrane of the larynx is a much more dangerous and fatal disease than a secretion of pus from the same part. From this circumstance the same mode of inflammation often varies in danger and intensity in different membranes. Thus suppurative inflammation, when it occurs in a serous membrane, is fatal; but when it attacks a mucous membrane, as that of the urethra or lungs, it is comparatively of little moment.

Neither are all parts equally liable to all these different forms of inflammation; for the mucous membrane of the nasal fossæ, of the colon, and of the small intestines readily takes on serous inflammation; but serous inflammation is entirely unknown to the mucous membranes of the stomach and œsophagus. Purulent inflammation is common to the mucous membranes of the lungs, of the colon, and of the urethra; but is unknown as a secretion from the mucous membranes of the stomach or small intestines, without breach of surface. The same form of inflammation, therefore, has different values, and is of different frequency in different organs and tissues. It is consequently necessary to study the phenomena of inflammation, as it occurs in each particular organ and tissue. We shall now point out a few of the more particular laws, as well as some of the general laws incident to each form of inflammation, in whatever organ or tissue it may occur.

Inflammatio diffusa is an abnormal collection of blood in the capillaries of a part, disordering its functions, and sometimes, when affecting principal organs, as the brain, causing death. It has two stages; and the circulation being in general much increased in the first stage, that is termed the stage of *active congestion*. In the second stage the circulation is in general retarded; and this stage has been termed that of *passive congestion*. In the first stage the capillaries circulate arterial blood. In the second stage, they acquire the power of converting the arterial into venous blood, and ultimately of expelling the colouring particles of the blood altogether. After this they recover their healthy tone and function, and the inflammation terminates, as it is termed, by resolution, or without the escape of any morbid product. This mode of inflammation and its various phases are constantly to be witnessed in inflammation of the white part of the eye, as in conjunctivitis. Diffused inflammation attacks every organ and tissue of the body; has in all cases a destructive tendency, and has no reparatory power, except when artificially produced as a counter-irritant.

Many physiologists have sought to illustrate the difficult subject of inflammation by exciting diffuse inflammation in the webbed foot of the frog, and in the mesentery of the rabbit. It is doubtful whether the frog is an animal liable to inflammation, but the rabbit unquestionably is; and the phenomena observed have been, that the colourless capillaries of the healthy membrane become enlarged and filled with red blood; that the velocity of the circulating fluid is at first increased, but after a time, if the inflammation is violent, the velocity is gradually retarded in the centre of greatest inflammation, till at last the circulation becomes stagnant at this point, and this stagnation, or "*stasis*," perhaps at length extends over the whole of the inflamed surface. Again, if the inflammation subsides, the circulation is gradually re-established from the circumference to the centre, the healthy affinities of the part slowly restored, the arterial blood again converted into venous blood, and ultimately the colour, circulation, and functions of the part once more become healthy and natural. This is nearly all the information acquired by microscopic observations on the subject of the proximate state of parts in inflammation generally, for beyond this the tissue becomes thickened and opaque, and a veil is cast over the further processes of nature which it has hitherto been in vain to penetrate. It is remarkable that this proximate state of parts, as far as we can trace it, is the first stage, not only to the diffuse but to the serous, the adhesive, and the suppurative inflammations; so that those different forms of inflammation evidently depend on an altered affinity of the capillaries of the part for the fluids which circulate through them, rather than on any physical difference of structure demonstrable in the part itself.

Another fact relating to diffuse inflammation, as well as to the other forms of inflammation, has been determined, or, that the larger blood-vessels of the part are enlarged and contain much more blood than usual; again, should the part not recover its healthy state, the capillary vessels are nearly obliterated, or rendered im-

pervious, since injections do not penetrate them as in health.

As a general principle, diffuse inflammation is said to terminate by *resolution;* that is, without any product whatever being effused; but this is not strictly correct, for when the inflammation has subsided the part is generally found thickened and opaque, some deposit having taken place either in its vessels or between their interstices. Much other injury is also usually done, for if a membrane be acutely inflamed, it is very readily detached, the cohesion of its connecting tissue being rendered extremely lacerable. Again, if an organ be acutely inflamed, it is rendered soft and easily torn: while on the contrary, if the same parts be chronically inflamed, the organ becomes indurated and the membrane strongly adherent. By these changes of cohesion the elasticity of parts, a circumstance often of very primary importance, becomes greatly altered and impaired.

In chromatons inflammations also the inflamed part has some shade of red; but this redness varies according to the tissue or organ. When, for instance, a serous membrane is inflamed, it is of a bright red or rose colour. On the contrary, if a mucous membrane be inflamed, it is of a deep red or venous colour, sometimes almost black; and though the colour of these parts is often represented as of a scarlet hue, this is probably owing to the part having been exposed to the atmospheric air before the draftsman saw it; for exposure to the air changes the original tint in a very few minutes to an arterial redness. It is perhaps owing to this latter circumstance that the conjunctiva of the eye and the mucous membrane of the mouth are generally of a bright red when inflamed. In like manner the liver, spleen, kidney, or other solid organ, when inflamed, is always of a deep venous hue.

When inflammation is of any intensity the functions of secretion and of absorption are greatly impaired. Thus, in diffuse inflammation the secretions of the part are stopped, and it feels dry, while its powers of absorption are so feeble that a strong poison placed in contact with the part either lies inert in it or is only slowly absorbed. These alterations of the powers of secretion and of absorption, though not so absolute as in diffuse inflammation, yet are common in a greater and less degree to all inflammations; and is a law by which we are enabled often to apply very stimulating applications, as mercurial ointments, to a diseased part without affecting the constitution.

Serous inflammation is when *diffuse inflammation* terminates with, or is attended with, *effusion of serum*, or of the more watery parts of the blood, the effused fluid, according to Kaltenbrunner, being thrown out in jets from the sides of the capillary vessels. This affection is for the most part destructive, though occasionally, as a counter-irritant, when excited by the action of a blister, its action is reparative. In *Serous* inflammation, even of a serous membrane, as the pleura, the fluid effused is not only greater in quantity than natural, but is also greatly altered in quality. In health the serous secretions are little more than a pure aqueous vapour, with a trifling addition of saline matters; but when they result from inflammation they contain a considerable quantity of albumen, sometimes a portion of fibrine, and at others pure blood, entirely unchanged in its physical properties. The quantity effused varies, according to the part affected, from perhaps a fraction of an ounce to a few pints, or even a few gallons. Serous inflammation is unknown as a disease of the liver, spleen, or kidney, of the bones or cartilages, or of the mucous membranes of the stomach or œsophagus.

Adhesive inflammation is when lymph is thrown out, or that portion of the blood which enters more particularly into the formation of muscular fibre. In surgery, if a party receive a wound, and the lips of the wound be immediately brought together, and the blood expressed—for the presence of much blood is inimical to the operation—a layer of lymph is thrown out, which becomes organized, forms a cicatrix, and the part heals by what is termed union by the *first intention.* Adhesive inflammation is so powerful in some tissues, that not only has a nose bitten off, or a finger chopped off, united, but even a large wound caused by amputation has frequently healed in two or three days, except where the ligatures were situated. In animals, even dissimilar parts will unite, as the testicles of a cock to the inner surface of the abdomen of a hen, or a spur removed has been planted on his comb. This property of adhesive inflammation is possessed by all organs and tissues in a degree sufficient to ensure union after division, and is the great agent on which the surgeon relies in all his great operations. In medicine, however, it is roused by a great variety of causes, besides mechanical accidents, and is always of a destructive tendency; for, effused into the substance of an organ or tissue, the diseased part becomes enlarged or thickened, giving rise to a large and formidable class of disease, little influenced by treatment. Again, if effused from the surface of a membrane, canals are obliterated; parts that should have motion are bound down, or else a false membrane forms, so prone to disease that the patient seldom long survives a most imperfect recovery. Considered as a diseased action, adhesive inflammation is possessed in very different degrees by different organs and tissues; thus lymph is often poured out in great abundance into the substance of the lungs, but in the liver, brain, spleen, or kidney, it seldom exceeds slight interstitial deposit. It is also frequently poured out in the greatest abundance from the serous membrane of the abdomen or chest, but it is infinitely less abundant from the serous membranes of the brain. It is common and abundant from the mucous membrane of the colon and larynx, but is hardly known as a secretion from the similar membranes of the stomach, œsophagus, or small intestines.

When adhesive inflammation takes place from a membrane, the lymph effused must act as a foreign body, inducing or keeping up a most destructive disease, unless it be removed or become organized. In serous cavities to remove it is impossible, and nature consequently adopts the latter process; first, as a means of fixing it and rendering it as harmless as possible; and again, by rendering it a living part to render it liable to be removed by absorption. The time of incipient organization after effusion is probably very short, and has been demonstrated by Mr. Hunter to have commenced as early as the 26th hour after the Cæsarian operation. Mucous membranes having an external outlet, the lymph effused can readily be removed, and has a ready exit. Nature, therefore, seldom induces the organization of lymph in these parts, but casts it out, so much so that organization of lymph, except in some of the smaller canals, is hardly known.

Suppurative inflammation is that process by which, in surgery, foreign bodies—a piece of detached bone, or

a splinter, is removed from the system. In medicine it is always destructive, and may be either a further stage of the preceding inflammation, or it may exist *per se*. Pus, the peculiar fluid now formed, is globular, specifically heavier than water, has a sweetish mawkish taste, is of a peculiar odour, and is of a cream colour. This fluid varies greatly in quantity and quality in the course of the same or different diseases, being greatly influenced by the health of the patient; or it may be said to vary from a laudable pus to a mere ichorous sanies. Pus also, besides possessing certain chemical properties, may also possess certain specific animal properties: thus it may be impregnated with certain poisons, as that of syphilis, or of the small-pox; it is also often loaded with many foreign matters, as urate of soda, &c.

Pus, when secreted by a sound membrane, has no known beneficial property; but when secreted at the surface of an ulcer, or open abscess, it affords considerable protection to the tender granulations, acts as a temporary cuticle, and sometimes forms a crust, but not constantly so, under which the parts heal. The origin of pus is a peculiar action of the vessels of the part, by which the particles of the blood are converted into pus. Some physiologists have supposed pus to be the red globules morbidly changed and enlarged; but the quantity of pus poured out, often exceeding a pound weight a day, and this for many weeks or months together, renders this hypothesis impossible. Pus is consequently a new formation, and in some cases appears to be extensively absorbed. Andral has collected blood from the dead body and found globules of pus; so that it exists in the circulating fluid, under certain circumstances, is beyond all doubt.

Pus is daily seen to be poured out from a sound serous or mucous membrane, and from the surface of ulcers; but it may also be formed into an abscess, and the abscess may be either *phlegmonous* or *infiltrated*, and in the former case there are many different varieties or modes of formation.

A phlegmonous abscess is when the pus is collected into one cyst, and is prevented from escaping by condensation of the surrounding tissues. The formation of this kind of abscess is very various in different diseases. In the formation of phlegmonous abscess the vessels of the inflamed part are first injected with red blood proportioned to the violence of the disease; this blood at length bursts from the containing vessels, and diffuses itself throughout the inflamed portion of the organ, and combines with its tissues. The tumor now feels hard, but nevertheless its texture is tender, easily broken down, and, if the inflammation now proceeds, pus is poured out first in small *foyers*, but which at length unite and form the abscess, the red pulpy mass being either absorbed or else changed by an ulterior process into pus. If the abscess be now allowed to ripen, a membrane of greater or less tenacity forms, and lines the entire cavity; the functions of this membrane are not confined to containing pus, for it most probably imparts to that fluid an obscure vitality, and gives it freedom from putrefaction; it is also an organ of secretion, and of absorption, and by its means the quantity of pus is increased or diminished, and its quality rendered more or less healthy. This membrane is united by a close sympathy with the constitution, and feels in a rapid manner its slightest changes; for when enfeebled from any cause, the contents of the abscess from laudable pus often become an ichorous and offensive sanies; while on the contrary, if the health improves, an ichorous sanies becomes laudable or healthy in a most remarkable manner; in a few instances the contents of a large abscess are sometimes absorbed by this membrane.

The above description of an abscess is generally true, but it is certain, also, that this process greatly varies in different tissues, and even in the same tissue. No one, for instance, can fail to observe a striking difference between an abscess of the liver and that occasioned by a boil or carbuncle. In the former the parts have undergone a general softening, and are converted into pus; while in the other the process of *ramollissement* has been so partial, that a hard and solid core is amongst the first products discharged. A small-pox pustule is an abscess, but how different its phenomena from either of the former; first a hard tumefaction, then a vesicle filled with serum, and this is subsequently changed for or into pus; it seems therefore proved that the phenomena of phlegmonous abscess are not uniform in the same, and much less in different tissues.

When an abscess points externally, the solid parts forming the outward barrier are softened, thinned, and ulcerated, till at last nothing remains to oppose the escape of the pus except the cuticle, which at length ruptures and the pus is discharged.

The walls of a phlegmonous abscess, it has been stated, are always so condensed by inflammation of the surrounding tissues, that the pus is prevented from escaping. When, however, the pus effused is neither limited by a proper membrane nor by any condensation of the surrounding parts, it permeates the limb or organ by its own gravity, and is termed *a diffuse abscess*.

The incipient formation of the diffuse abscess is probably not dissimilar to that of a phlegmonous abscess, but as the inflammation is of a lower character all the processes are less complete; thus, no adhesive inflammation circumscribes the limits of the abscess, nor does any membrane form to contain the pus. The process of *ramollissement* is also imperfect, so that the abscess often contains shreds, or even large portions of mortified or loose cellular tissue. The pus secreted is also less healthy, is thinner, and less perfectly elaborated, containing a larger portion of serum, and oftentimes portions of loose lymph without a trace of organization. The pointing of this form of abscess differs also from that of the phlegmonous abscess, for the pus readily passes from its original seat by infiltration of contiguous portions of healthy membrane, and, gravitating towards the most depending position, presents a soft broad surface without any indications of pointing.

Such collections of matter are always of greater extent than phlegmonous abscesses, for the free transmission of pus from part to part occasions a great extension of the original disease. When these diffused abscesses are opened, the phenomena which result depend very much on the nature of the opening. "I have," says Mr. Hunter (note, p. 395), "seen large lumbar abscesses open of themselves, on the lower part of the loins, which have discharged a large quantity of matter, then closed up, then broke anew, and so go on for months, without giving rise to any disturbance: but when opened so as to give a free discharge to the matter, inflammation has immediately succeeded, fever has come on, and from the situation of the inflamed part as well as from the extent, death in a very few days has been the con-

sequence." The same result has also occurred from opening *large* diffuse abscesses in other parts. In erysipelas, however, which so often gives rise to this form of abscess, a free opening is often necessary to allow of the escape of the portions of loose cellular tissue they contain.

Of *Ulcerative* inflammation there are three forms, as suppurative ulceration, serous ulceration, and dry ulceration. Most sores are instances of the first, the effects of a blister are instances of the second, and the last is sometimes seen in syphilitic maculæ, when a process of slow ulcerative absorption goes on without a trace of fluid of any kind being effused. All tissues are not equally liable to ulceration. The muscular tissues are less so than the adipose, and the adipose than the cellular tissue. It is from the operation of this law that abscesses sometimes point at very distant parts, as a lumbar abscess in the groin, and thus many important parts are for a time saved.

Granulation is an union of parts by "second intention," and is always reparative. Granulation has two forms, or granulation with suppuration, and granulation without suppuration. The first is extremely common. The latter is occasionally seen in the healing of syphilitic maculæ; and Mr. Hunter conceives he once met with it in the union of a broken thigh-bone.

Granulation, according to Mr. Hunter, results from an exudation of lymph, into which old vessels extend, and new ones are formed, and a new surface results, which is "granular"—the granule, in the opinion of modern physiologists, being a small conical tumor, or growth, composed of a mesh of terminal loops formed by the capillary vessels shooting into the effused lymph. The figure and colour of the granulation, says Mr. Travers, are determined by the state of the circulation; when that is feeble and inclined to stagnate, the granulation is broad, flat, and spongy, and either pale or of a livid hue; when, on the contrary, it is vigorous, the granulation is conical or acuminated, and of a bright red tint. The vessels prolonged into the granulation are more or less tortuous, and so numerous as to require a high magnifying power to exhibit their distinctness after successful injection. These vessels become contracted to obliteration as the period of cicatrization approaches. Granulation may take place from a surface, or from the sides of an abscess. If from the cutaneous tissue the sore heals by a process of skining; the skin, according to Mr. Travers, always springing from the edges of the wound, even in cases when the new tissue first appears in the central parts. Again, if granulations spring from the walls of an abscess, their opposite surfaces for the most part unite. Granulations sometimes form most rapidly, for Mr. Hunter has seen, after trephining a patient, the dura mater strongly united to the scalp in 24 hours. Granulations, however, have not in all cases an equal disposition to unite. Thus the granulations of fistulous abscesses are little prone to adhere, their surfaces being often as difficult to unite as those of a mucous membrane; indeed it is often impossible to produce adhesion except by exciting a considerable inflammation. A part having healed by granulation uniformly contracts. This contractile force is so great that although the sore made by the amputation of a thigh is seldom less than seven or eight inches in diameter, yet the cicatrix left on healing is hardly more than a crown piece. It is from this cause that we always find in viscera that have been the seat of abscess a marked depression at the point of cicatrization.

With respect to the granulations themselves, there is no question of their being furnished with nerves, absorbents, and secretory vessels, for the part is pained when touched; pus and lymph are secreted, and poisons, as mercury or arsenic, are absorbed by them; and although they are not powerfully absorbant, yet such quantities have sometimes been taken up as to have caused the death of the patient.

The reproductive energy of granulation, however, is not great, for it is rare that the original tissue is reproduced. No fat, for instance, is regenerated in ulcerated adipose tissues; a muscle being divided unites by a cellular cicatrix, no muscular fibre being reproduced, and a divided cartilage unites by a ligamentous, but not by a cartilaginous tissue. The skin, when destroyed, may be reproduced, yet generally it is imperfect, for after small-pox the rete mucosum is either slow in forming, or never forms at all, so that the pit remains whiter than natural. The reparation of the mucous membrane is equally imperfect, the villi being always wanting. The reparation of a flat bone, as the cranium, is so slow that 10, 20, and even 50 years pass away before a small trephine hole is filled up with bony matter. In like manner a healed cavity of the lungs is always marked by a cicatrix of cellular tissue, altogether different from the original structure; neither, as far as we know, is the fibre of the liver, of the spleen, or of the kidney restored. It is doubtful whether a divided nerve is ever united by nervous matter; many pathologists think not, but conceive that when a part has recovered its sensation or motion, after such an operation, that a cellular cicatrix of extreme tenuity forms, through which the nervous fluid can penetrate,—that fluid, like electricity, having possibly a striking distance.

It is a law also of all cicatrices, that the newly formed part is harder and of greater density than the original structure. Muscle, for instance, unites by coarse, dense, cellular tissue; tendon by bone; and bone after a fracture is a more compact substance, and contains more phosphate of lime than before the accident; but, notwithstanding this addition, the new bond of union is not so strong, nor the living principle so energetic, as in the original structure; for when the constitution has been enfeebled by severe disease, an old sore has been known to open, and the ends of a once broken bone to separate. It is equally a law that a part having been once inflamed, the liability of the part to that form of inflammation is greatly increased; and also when new membranes or tissues have formed, that these tissues are infinitely more prone to every form of disease than the original membrane.

Mortification is the death of a part, and may be complete or incomplete. In the soft parts the former is termed sphacelus, and the latter gangrene; while in hard parts, as the bones, there is a similar distinction, or into caries and necrosis.

Mortification of the soft parts may be white or black, humid or dry. Black mortification is when the venous blood is extravasated through the walls of the blood-vessels into the affected tissues, giving to the part a purple or black appearance, while to the touch it is soft, inelastic, and doughy. White mortification is when, by the action of cold, the blood has been driven from the part, and the part subsequently freezes perfectly white; but,

although frozen, the vitality of the part is not destroyed, for it can be recovered by proper treatment; on the contrary, if the treatment be indiscreet, as warmth suddenly applied, it thaws, re-action takes place, the part becomes immensely swollen and inflamed, and is ultimately destroyed.

Humid mortification is when the blood transudes in a fluid state, and after its exudation probably separates into its constituent parts, so that the serum set free raises up the cuticle in bladders, forming what are termed phlyctænæ: air is also not unfrequently contained in the phlyctænæ, generated by a process of commencing putrefaction, giving to the finger touching the part a sensation of crepitation.

Dry mortification is a rare disease, and is supposed to be caused chiefly by the ergot of rye, but this is probably an error. In the year 1716, dry mortification appears to have been to a certain extent epidemic at Orleans, 50 cases having been treated at the Hôtel-Dieu of that city. Dodard has described it as beginning generally in one or both feet, with pain, redness, and a sensation of heat or burning like that produced by fire. At the end of some days the part became cold, as black as charcoal, and as dry as if it had been passed through fire. Sometimes a line of separation was formed between the dead and the living parts, and the complete separation of the limb was effected by nature alone, and in one case the thigh separated in this manner from the body at the hip joint. In other cases amputation was necessary. Mr. Solly has given an interesting case of this description, which occurred in the practice of Mr. Bayley, of Odiham. The party was a child 3 years and 7 months old, from whom both arms were removed, by this spontaneous process of nature, above the elbow, the left leg below the middle of the thigh, and the right foot above the ankle joint, being a remarkable instance, in modern times (*R. M. C. Trans.* vol. xxii. 23), of this destructive disease.

The bones, the brain, the lungs, the liver, the spleen, and the kidney, are all liable to sphacelus and gangrene; so are the different tissues, as the cellular and cutaneous tissues, the nervous and serous tissues. The muscles, tendons, aponeuroses, and blood-vessels, are likewise all liable, but in a less degree, to these formidable affections, which are sometimes the effect of inflammation, and again are in some instances idiopathic.

The pathology of the soft parts has been carefully studied in mortification, but little more has been discovered than what has been stated, or extravasation of blood, and its coagulation in the capillary, as well as in the larger vessels, together with great softening of the tissues of the part. The extent to which the coagulation extends in the large vessels is often great; for incisions made during life, four inches above the apparently dead parts, have in some instances not been followed by hæmorrhage.

Of the Constitutional Effects of Chromatous Inflammation.

There is so close a sympathy existing between the different organs and tissues of the body, that the functions of one being subverted or disturbed, the rest more or less generally fall into disease. Every local inflammation, therefore, of any intensity creates a shock which deranges remote and distant parts, and which is termed the *constitutional* affection. In the present state of medicine it is impossible to unveil the mysterious laws of the nervous system by which the different effects are conjoined, but some authorities suppose the morbid impression is transmitted by the nerves of the part, in slight cases, to the nearest nervous centre, in severe ones, to the brain, whence it may be transmitted to the system generally, causing headache, nausea, or diarrhœa, phenomena which they imagine to be caused by a simple affection of the solids. On the contrary, there are other physiologists who conceive these same phenomena to be caused by matter absorbed from the wound, and therefore to result from a contamination of the fluids. All theory apart, however, the constitutional affections may be limited to a mere affection of the pulse; to a disturbance of the alimentary canal, causing loss of appetite, sickness, diarrhœa, or constipation; to an affection of the liver, or of the brain, or chord, as when a trifling wound is followed by tetanus. These sympathetic affections, however, whether taken separately or conjoined, do not denote any particular form of inflammation, neither do they mark any particular seat of inflammation, for a whitlow is as likely to produce any or all of them as an abscess of the liver. There is one law, however, which ought not to be passed over, which is that remarkable difference of pulse which exists between severe inflammation of a serous or of a mucous tissue; or in the former it is small and extremely rapid, while in the latter it is perhaps natural, or but little accelerated.

When the constitutional affection is general and produces fever, the fever may precede the local inflammation, or it may occur at some subsequent period. In the former case it will ultimately be found in all probability that the cause of the fever is a morbid poison, and if so, the latter instances will form the only true cases of sympathetic or symptomatic fever. Assuming then the symptomatic fever to follow the inflammation, it may occur at two different periods, or shortly after the attack of inflammation, or immediately before suppuration takes place.

Symptomatic fever has a distinct connexion with the local disease, for that being healed it immediately subsides. It does not, however, necessarily mark any peculiar form or degree of inflammation, for the fever which ushers in an erythematous eruption is often as considerable, or even more so, as that which accompanies a fatal pneumonia or hepatitis. The same form of inflammation, even in similar membranes, is attended with very different degrees of fever. Thus serous inflammation of the pleura, or of the peritoneum, is seldom accompanied by much fever, while sero-arachnitis is very constantly so. Again, adhesive inflammation of a serous membrane, as the pleura, is often accompanied by some fever; but lymph poured out from the mucous membrane of the larynx, as in croup, or of the colon, as in some forms of diarrhœa, is seldom accompanied by fever.

When inflammation is established and proceeds to suppuration, a severe paroxysm of shivering is often the first indication of the formation of the abscess, or of the effusion of pus, but the degree of symptomatic fever varies greatly even in this case, for a most copious secretion of pus may take place from a mucous membrane, as that of the bronchi or urethra, and the constitution hardly suffers from any appreciable degree of fever, while a trifling amount of pus from a serous membrane is often followed by fever of a fatal character.

In any case the character of the fever depends on the constitution of the patient, for if that be good the fever is attended with a white tongue, much heat, a full and strong pulse, and with little tendency to a brown tongue.

On the contrary, if the patient's constitution be broken, the fever is of a low type. In the event of an abscess forming, the fever is often sthenic during the earlier periods of the inflammation; but as soon as the abscess ripens, if any important organ is its seat, the fever becomes asthenic, with a brown tongue and a rapid pulse, while the local pain in a great measure subsides. At this period the abscess must open either spontaneously or by art, or otherwise the patient for the most part dies. The opening of the abscess, though attended with much pain from the contracting of the inflamed walls, is usually followed by great relief of all the constitutional symptoms, and the pulse rises, the tongue cleans, the appetite returns, and a visible and immediate amendment takes place. If however the patient has been exhausted by his sufferings in the earlier stages of the disease, the relief afforded is but transient, the pus secreted degenerates into a sanies, or is altogether suppressed, the fever changes to typhoid, and the patient sinks, too enfeebled to establish the reparatory process.

It is remarkable, however, that a patient who would be destroyed by a continuance of the suppurative inflammation is often preserved by substituting a process of adhesive inflammation, or of union by the first intention, for that by granulation, or by the second intention, showing that the part is often in one state while the constitution is in another. It is upon this principle the surgeon acts in amputating after a severe compound fracture, or for intractable suppurating diseases of the joints, the constitution having the power to heal a simple wound, though not a suppurating one.

Another law of inflammation is, that for the most part an interval more or less long elapses after the application of the cause before the occurrence of either local or constitutional phenomena. A patient, for instance, receives a violent concussion of the brain; in a short time he recovers himself, and is able to walk home; but a few days after he is seized with arachnitis, or other local inflammation. A person, after being exposed to cold or wet, seldom suffers an immediate attack of inflammation, but the next day, or two or three days after, inflammation of some organ or viscus is established, and the lapse of a similar interval takes place after the application of any other cause.

When the constitutional affection or fever assumes an intermittent type it is termed "*Hectic.*" The paroxysm of hectic usually comprises three stages, or a cold stage, a hot stage, and a sweating stage, but in many cases one or even two of these may be wanting. The cold stage, for example, may be followed by the sweating stage, and this is the cold clammy hectic which patients so much dread; or it may be composed of a hot stage, followed by a sweating stage, which so constantly takes place in the morning in phthisical patients; or the paroxysm may consist of a hot and cold stage, or of a hot, or a cold, or a sweating stage only.

Hectic fever is usually supposed to designate a chronic abscess, and especially an abscess of the lungs; still, it often accompanies chronic disease of the liver, or spleen, in which no suppuration is present. Mr. Hunter has laid it down as a law in surgery, that the further a diseased part is from the source of circulation, the earlier this constitutional affection is formed; or that it occurs sooner when the ankle or wrist joint is affected, than when the hip or shoulder joint is the seat of a similar disease.

General rules of treatment in simple Inflammation.—The great remedies we possess in subduing simple inflammation are bleeding, certain medicines, and topical remedies. The medical treatment of inflamed parts varies greatly according to the organ or tissue affected, and will be best treated of under each respective head of inflammation, but it may be proper to say a few words about bleeding.

Bleeding, by diminishing the quantity and altering the quality of the blood, has a direct tendency to reduce the excitability of the nervous system, and thus to abate the action of the heart and arteries; and if inflammation were merely an increased action of parts, we should only have to apportion the quantity of blood drawn to the increased force or power to cure the disease. Nevertheless, we find in practice that this most powerful of therapeutic agents in the cure of inflammation often requires the greatest caution in its employment; for there is a line beyond which bleeding becomes destructive instead of remedial; and consequently it seems to follow, that in a great number of cases inflammation is something more than increased action. Some general rules are therefore necessary to guide us in the use of the lancet; and none perhaps are of more importance than that its utility varies according to the nature of the cause, the organ affected, and the state of the blood.

There is no truth, perhaps, in medicine more conclusively determined than that we ought not to bleed, or to bleed sparingly, when the inflammation depends on a morbid poison. In epidemics, therefore, of every kind we should not hastily have recourse to the lancet, but should remember the disease probably depends on a poison, has a course to run, and is not amenable to the mere abstraction of blood. Again, the nature of the membrane or organ affected must always be considered in estimating the propriety of bleeding. If a serous membrane, for instance, be acutely inflamed, the patient, for the most part, bears bleeding well, and is usually greatly relieved by it. Inflammation of mucous membranes, however, though occasionally relieved by bleeding, is seldom cured or even greatly influenced by that operation. Another law also which experience has determined is that, as a general principle, diseases of the skin bear bleeding badly, and even when most acute, the patient often sinks if a large quantity of blood be taken. With respect to organs, likewise, it is found that inflammation of the brain is less influenced by bleeding than inflammation of the liver, and inflammation of the liver than inflammation of the lungs.

The next consideration is, what indications for bleeding are to be drawn from the state of the blood? In the great class of febrile diseases, says Andral, the fibrine never augments, remains often in normal quantity, and is also often diminished. In the phlegmasiæ, on the contrary, there is a constant augmentation of this principle; the fibrine being in excess compared with the red globules, and instead of being 3, as in health, oscillates between 4 and 10. It is this excess of fibrine which gives firmness to the clot, and is the cause of its being buffed and cupped. The immediate effect of bleeding, according to the same high authority, is to reduce the red globules instanter, but not so with the fibrine; for a reduction of fibrine does not take place till after a certain time, bleed as you may. Such is the state of the blood in the phlegmasiæ. There are many reasons, however, for not esteeming the buffed and cupped state of the blood denoting an excess of fibrine as a sufficient warranty for bleeding; for these conditions are often pre-

sent in erysipelas, phthisis, or the early stages of typhus; and in either case the loss of a moderate quantity of blood might hurry the patient to his tomb. Again, in acute rheumatism the blood is not only buffed and cupped, but contains a maximum quantity of fibrine; yet the best practitioners seldom think it necessary to take blood, considering that mode of treatment as neither affording present relief, nor shortening the course of the disease. The fact, then, of the blood being buffed and cupped does not, in all cases, warrant venesection; indeed it is calculated that three-fourths of the victims of mala praxis perish from deducing the rule of treatment solely from the state of the blood. "Bleed daily as long as you see the blood inflamed," was the direction of a naval surgeon to his assistant. The order was strictly obeyed, and thus, adds this gentleman, "I sent many a brave fellow to a watery grave." It follows, then, that in addition to a given state of the blood, certain symptoms must also be present, as well also as the probability of a certain cause, to induce us to bleed largely in inflammation.

There are many circumstances, therefore, which prevent the blood from being an unerring guide for bleeding in cases of inflammation. Still, the blood does offer certain therapeutic indications either for bleeding or not bleeding when the symptoms would otherwise demand or forbid this operation. The firmness of the coagulum, for example, has been considered, at all times, as a mark of the tonic state of the system, and as a warranty for repeating the bleeding when the part is as yet unrelieved; while, on the contrary, a looseness of texture is a sure sign of great debility, so that unless other circumstances strongly indicate the necessity of bleeding it ought not to be repeated.

The proportion of the serum to the clot, and also its occasionally altered characters, are arguments also for or against bleeding. When the quantity of serum is unusually large, unless the clot be very firm, bleeding ought not to be repeated. Also when the properties of the serum are so altered that it coagulates and forms one mass with the clot, bleeding is constantly prejudicial; and lastly, it has heen observed, that when the serum, which has little or no affinity for the red globules in health, readily dissolves them, that this is an unerring sign that further bleeding should be avoided, unless no hope remains of saving the patient by any other means.

It is well known that the sthenic or buffed characters of the blood are often greatly modified by the manner in which the blood is drawn; thus, if an individual be bled in both arms, but the blood allowed to flow with different velocities, or in a full stream from one and slowly from the other, the blood drawn is identically the same, yet a thick buff will be wanting in the latter, and be present in the former. Also, if the apertures be of different sizes, the same differences will result; or the blood from the larger orifice will be buffed, while no such effect is seen in the blood drawn from the smaller one. Again, the form of the vessel which receives the blood, as whether it be flat or conical, and also its temperature, or whether the blood be received into one that is cold or warm, will also affect the phenomena of its coagulation. In this difficulty, Mr. Thackrah has furnished us with a most useful rule to correct the error, or to observe the time of the coagulation of the blood. Everything that tends to debilitate the body, or to exhaust the nervous energy, facilitates the coagulation of the blood; or supposing it takes five minutes for blood to coagulate in health, if the patient faint, it will coagulate in two minutes.

In brutes the force of coagulation increases in proportion as the powers of life are impaired, and often in a striking manner; thus, the last portions of blood that flow from a slaughtered animal, as the ox, coagulate much more rapidly than that which follows the knife. If blood also is taken from a dog when he shows much alarm, it coagulates almost immediately. But the most striking proof is perhaps given by Fontana, who found that although the poison of the viper, when mixed with blood recently drawn, does not affect the time of coagulation, still that this substance injected into the veins of a rabbit caused instant coagulation, followed by the death of the animal. It seems, therefore, proved that the time of coagulation is diminished in proportion to the debility of the animal.

Of Achromatous Inflammations.

Achromatous inflammations, or those in which we find the effects of inflammation or its products without any trace of redness, form a class of diseases which, though numerous, has hitherto been little studied. They have no stage or form corresponding to diffuse inflammation, but consist of serous inflammation, which, when it affects organs, as the brain, has been termed Malaxoma, and is the ramollissement of the French, of adhesive inflammation, including hardening of parts or Scleroma, and also the purulent ulcerative and gangrenous inflammations, and these may be either acute or chronic.

Serous achromatous inflammation is very constantly met with in the abdomen, the peritoneum being of a silvery whiteness, opaque, and greatly thickened—effects evidently the result of inflammation; its cavity also is at the same time filled with turbid serum, sometimes containing portions of fibrine. The more remarkable form, however, of achromatous serous inflammation is when it attacks the substance of an organ or tissue, oftentimes rendering it whiter and softer than natural; and in some cases, so loaded with serum as to be almost diffluent, and hence termed malaxoma or ramollissement. Thus, in fever, or after a severe blow on the head, the brain, or some portion of it, is often unnaturally white and exceedingly soft; a state of parts unquestionably the result of inflammation, for the symptoms most commonly are extremely violent, while the membranes are found in every state of inflammation, and adherent generally to the diseased portion of the brain. The same achromatous state of inflammation is frequently met with in a more chronic form; and in many instances the brain is so soft that serum can be expressed from it in considerable quantities. Ramollissement equally attacks the spinal cord, the tissues of the alimentary canal, the heart, the muscles, liver, spleen, and indeed all the organs and tissues of the body.

Achromatous adhesive inflammation is marked by the directly opposite phenomena of malaxoma, or of induration or *scleroma*. Thus the brain or chord is occasionally found as hard as blanche mange, or the white of egg boiled hard; a morbid condition which seems hardly explicable on any other ground than the assumption of a colourless inflammation, for not a trace of a red vessel is to be seen. We also often find the tubuli of the kidney almost cartilaginous, and yet not the slightest injection. It is probably owing to this mode of disease, that adhesions and false membranes

are so often formed in the chest and abdomen, not only without the slightest consciousness of disease on the part of the patient during life, but without any appearance of a red vessel after death. If this law be admitted, we must attribute to it the many enlarged and hard spleens, livers, and kidneys. Many old chronic cases of gout or rheumatism of the joints are probably of this character, as well as syphilitic nodes of the bones.

Achromatous suppurative inflammation is often met with on the backs of soldiers on a march, the weight of the knapsack causing abscesses to form at the points of greatest pressure, but these abscesses often form without pain, heat, or redness. We also sometimes find a large abscess in a pale liver, and not a red vessel to be seen. In the lungs also grey hepatization and abscesses around tubercular matter are constantly seen, and yet no sign of increased redness or vascularity. In the brain also abscesses of a similar white formation are sometimes met with. In mucous membranes similar achromatous inflammations are very common: pus is often secreted from the bronchial membrane, the colour of the membrane being natural; and who has yet been able to decide whether a woman does or not in many cases labour under gonorrhœa—the parts in this disease seldom presenting any alteration of colour? The same absence of redness is also occasionally seen of the pericardium or peritonium, those cavities being full of pus.

Achromatous ulcerative inflammation is seen in many instances. No more strenuous battle has been fought by anatomists than whether cartilage is or is not endowed with organic life. Since, however, we observe cartilage swollen and softened, indurated and thinned, and often extensively ulcerated, no doubt can exist of its vitality; yet to the naked eye, in all these diseases, there is not a red vessel visible. In phthisis we often find the plaques de Peyer ulcerated, and yet the membrane is paler than natural; bones and cartilages are often destroyed by ulceration, the parts being so pale that Mr. Hunter has termed it interstitial absorption.

Even some forms of mortification are achromatous, as the mortification in frost-bitten parts, and to which we have before referred; but taking all these forms of achromatous inflammation together, the best and most striking examples are to be found in the proper coats of the arteries, which are often thickened and thinned, softened, indurated, and ulcerated, with an entire achromatous state of the parts. It is probably owing of the existence of some of the preceding forms of disease that we owe the formation of cysts, and of the states of hypertrophy and of atrophy.

Cysts are occasionally formed in all parts of the body, as in the brain, the lungs, liver, spleen, or kidneys. They are also common among the bursæ, on a mucous follicle, a Graafian vesicle, and the cells of the parenchymatous tissue generally. The formation of these cysts depends probably first on an achromatous serous inflammation, followed by an altered balance of secretion and absorption. The cyst once formed, the globule of serum, instead of being absorbed, is multiplied, thus making a pressure which enlarges the cyst, whose walls become thickened by a continued achromatous adhesive inflammation. These cysts are of various sizes; and in the interior of the mouth, or along the edge of the tarsi, they are seldom larger than a pea; in the brain they are sometimes met with as large as a pigeon's egg; while in the ovarium, where they attain their largest magnitude, they often contain two, three, or more gallons. When small, the cyst is generally single; but when of great size, it is more commonly, especially in the ovary, multilocular, the tumor being composed of five or six, or more different cysts. These cysts are liable to inflame and become cancerous, and the seat of tubercular formations.

The external membrane of these cysts is very various, often transparent, thin, and delicate; but in other cases opaque, dense, of considerable thickness, occasionally cartilaginous, and in rarer instances ossified. Their contents are even more diversified than their structure, being generally serum, with little foreign matter; but at other times mixed with large portions of albumen, either in solution, thrown down in flakes, or otherwise precipitated. At other times the contents resemble honey and water, while, if they inflame, we often find lymph, gelatiniform matters, pus, and sometimes a dark fluid, like chocolate or coffee grounds, evidently discoloured by a morbid state of the colouring particles of the blood. The contents of these tumors are sometimes still more remarkable, for when situated in the scalp they sometimes burst, and a secretion in a semi-fluid state exudes and concretes into a dense substance, having the appearance of a horn curved and tortuous, and much resembling those of the inferior animals. These horns, termed plica Polonica, have measured nine inches in length, and from two to three in circumference, and may be removed with the knife with impunity.

The most singular of all the varieties of these tumors is that which, instead of containing the matters which have been mentioned, sometimes contains teeth or hair. Thus Mr. Barnes found in a double encysted tumor of the orbit both teeth and hair. Lobstein gives the case of a man, aged 50, in whom in the course of three months a cyst formed, which, being opened, contained three teeth, each in a separate cyst. In another case, in a cyst connected with the abdominal diaphragm, fat, hair, and four teeth were found. Rysch found four teeth in a tumor of the stomach. These instances might be largely multiplied, and their most frequent seat is the ovary, of which an instance occurred in St. Thomas's Hospital only a few days ago. The encysted teeth are formed according to the same laws as ordinary teeth. They arise from isolated capsules filled with a gelatinous fluid, and if by chance the osseous portion is wanting, the gelatinous is present. Like ordinary teeth, the crown is formed before the root. When there is more teeth than one, their growth is not always simultaneous, for some are yet germs; others milk teeth, while others are the perfect second teeth, and in some cases the milk teeth are found to have been replaced by second teeth. Molar teeth are more frequently met with than incisors; but in all instances the teeth found are similar to those of the animal generating them.

The hair also found growing in these cysts varies in length from two or three inches to twenty or thirty; has always a bulb and root similar to hair of ordinary growth, and may be black, red, brown, or grey, and two or more of these colours have been found in the same cyst. These cysts are said to be lined with cuticle, which may desquamate, and they generally contain some atheromatous matters. Hair has also sometimes been found growing from the surface of membranes, as from under the tongue; from the mucous membrane of the gall-bladder, or bladder, and from the testicle.

Besides the serous cysts which have been mentioned, there is a class of vesicles or serous cysts, which are

Elementary Principles of Medicine.

supposed to have an independent life, and are termed hydatids. There are several genera of this kind found in animals, but two only appear to be peculiar to man, or the cysti-cercus and the acephalo-cystis. The cysticercus has a head somewhat resembling that of a tænia, and a nearly cylindrical body, terminated by a caudal vesicle, and generally exists singly. Dr. Sharpey states he has repeatedly met with them while dissecting at Berlin. The acephalo-cystis, however, is that which is most frequently met with in man, and these have neither head, neck, or visible extremity.

The coat of the acephalo-cystis is a serous membrane of great tenuity and delicacy, so as to be almost transparent, and only, in a few instances, is it opaque or dense. It contains an aqueous fluid nearly pure, and in size varies from less than a pea to a goose's egg. The acephalo-cystis, when it acquires even a very moderate size, often contains a number of smaller hydatids, and these again may contain others of less magnitude than themselves, like a child's nest of boxes. Taking them collectively, they often exist in large numbers; the abdomen in some cases of ascitic dropsy containing many hundreds or thousands. Of the generation of these parasitical animals we know nothing, neither are they supposed to be of long life, for in the pig, if generated in the spring, they appear to die in the autumn, while in man it is doubtful if they live a twelvemonth. The vitality of these cysts, however, is very obscure, its only proof being that they are said to have contracted when thrown into hot water, but even this indication is often wanting.

These animals affect every part of the body, as the brain, spinal cord, the substance of the lungs, the cavity of the chest, the liver, spleen, pancreas, and kidney; the cavity of the abdomen, the tonsils, the uterus, the bladder, the muscles; while sometimes they are embedded in the substance of the bones.

Such are some of the forms and modes of *achromatous* inflammation, which, taking them altogether, form a most extensive class of disease, and contribute in a large proportion to the general mortality. If we look to their causes we shall find in them every error of diet, and all those unhealthful circumstances which congregate about men living in towns and cities. They are for the most part secret in their course, form without pain, and are only denoted at first by occasional disordered action of the part, which increases in frequency till at length the associated viscera and then the constitution take the alarm. The constitutional symptoms are not so uniform nor so marked as in chromatous inflammations; but still they have in many instances a general resemblance to each other, and are greatly more fatal. Has the patient a diseased valve of his heart, he for the most part dies of dropsy; has he an enlarged and otherwise diseased liver, he becomes dyspeptic, perhaps jaundiced and dropsical; has he a diseased spleen, he suffers from dropsy, and generally dies of hæmorrhage. It is in this class of disease that our remedies are so inefficient, and the practitioner will deserve great honour who shall be fortunate enough to discover medicines which may diminish their fatality.

Of Hypertrophy and of Atrophy.

Hypertrophy and Atrophy are among the most frequent phenomena in pathology. Hypertrophy is an abnormal enlargement of the organ or muscle without any apparent change in its healthy structure. Considered pathologically, however, the functions of a healthy organ so enlarged are seldom healthily performed, for an abnormal increase of the powers of the heart uniformly destroys the natural balance of the circulating forces, and ultimately leads to the death of the suffering party. Again, an enlarged liver, even when most healthy in appearance, is for the most part followed by jaundice and dropsy; while a patient labouring under a hypertrophied heart generally suffers from palpitation and asthma, and ultimately falls perhaps from apoplexy or dropsy. It is certain, also, that most hypertrophied organs are for the most part abnormal as to form, the hypertrophied liver being generally enlarged only at its left or at its right lobe. The hypertrophied heart is also generally misshapen, pouchy, the strength of the walls of its different cavities disproportioned to each other, while the capacity of its chambers are of different and of abnormal content. In some instances, as in double organs, the law of hypertrophy is reparatory. Thus if one kidney be atrophied the other usually becomes hypertrophied, and its power of secretion proportionally increased; yet this organ is more likely to become deranged than when the usual provision of nature for the performance of the urinary function is perfect. In like manner, we see the muscles of the leg by exercise acquire a power which may rupture the tendon Achillis, or even snap the bones of the leg asunder. Every organ, even the brain itself, is liable to become hypertrophied, and so is every tissue. More commonly the hypertrophy of tissues is partial, as warty growths from the skin, exostosis from the bones, polypi from mucous membranes, and more particularly a morbid deposition of fat in the adipose tissues. We will now point out some of the more remarkable circumstances connected with the two latter forms of disease.

Polypus is a common species of tumor usually attached to a mucous surface. The simple mucous polypus has a shining appearance, being invested by an extremely delicate membrane resembling a mucous membrane, and moistened apparently by a mucous secretion. It is of a soft consistency, homogeneous in structure, and generally of a semi-transparent light brown colour. In shape it is pyriform or clustered, one or more being suspended from a narrow pedicle or stalk. It seldom attains a large size, possessing but little vascularity, and is nearly devoid of sensibility. The seat of polypi is more especially the nose, uterus, bladder, larynx, œsophagus, stomach, and colon. Fibrous tumors also sometimes spring from the dura mater.

Polypi often become malignant from cancerous deposition, and in this case the disease extends not merely to the mucous membrane, but also to the surrounding parts. Most frequently it is encephaloid in character, and presents a cauliflower appearance, its surface being studded with numerous excrescences of medullary consistency.

Sometimes the adipose tissue is alone hypertrophied, or the seat of *Steatoma*. The person generally in childhood and in advanced age is liable to an embonpoint or increase of fat; but this increase of fat is sometimes a disease, and appears in parts not naturally its seat, and many organs and tissues are consequently capable of undergoing this fatty transformation or *steatoma*.

The muscles are the organs most liable to this transformation, and not merely to a simple accumulation and interposition of fat between the muscular fibres, but these

fibres themselves are sometimes converted into steatomatous substance. The muscles of the lower extremities are more disposed to a fatty degenerescence than those of the upper, and we can sometimes trace the progress of this transformation, for by the side of fibres which still preserve their natural appearance, we often see others that are white, and also other fibres which have already experienced the steatomatous conversion. The heart is also occasionally seen to have more or less generally undergone this degenerescence, and, strange to say, is sometimes converted into little more than a soft fatty membrane.

The liver, especially in phthisis, is often found to be loaded with fatty matter, or the seat of steatoma. In this case it is of a pale yellow colour,—preserves the impression of the finger, and, according to Vauquelin, has been found to contain as much as 45 parts of a yellow concrescible oil, greasing the scalpel, and causing paper smeared with it to burn as if dipped in oil.

The kidney is also often liable to this fatty transformation. Dupuytren and Lobstein have both seen the pancreas converted into fat, while Sir Astley Cooper found much fat in the substance of the lungs of his late Majesty George the Fourth, and fat has also been observed in the ovary and testicle.

The membranes are also occasionally the seat of steatomatous tumors; thus Mr. Abernethy found a portion of fat hanging pendulous from the surface of the peritoneum, and several instances are recorded of stearine having been found in the arachnoid. Some short time ago a fatty tumor was observed in a subject examined at St. Thomas's hospital hanging pendent from the mucous membrane of the intestinal canal.

When we observe how extensively the steatomatous conversion prevails, we may infer that under certain conditions of the animal economy it is probable it may take place in all tissues and organs. Its most common seat, however, is the integuments of the body, which may be general, as in the case of Daniel Lambert; or it may be partial, forming a greater or less number of fatty or steatomatous tumors. These are ordinarily pediculated, and have sometimes four or five roots of unequal length; and it is by these pedicles that the vessels are introduced. They are often encysted, and are inconvenient only from their size. The extent to which they may occur may be seen in the following case, taken from the *Revue Médicale*:—The patient was a young woman in good health, but who, although thin and of the middle size, weighed 169 French pounds. Between her shoulders were two adipose, or fatty tumors, 8 inches long and 3 inches broad; a third, of less size, was situated near the arm-pit; and a fourth arose from the inferior angle of the shoulder blade, and was 15 inches long and 6 inches in breadth; a fifth, lower down, was 6 inches long and 5 inches in width; the sixth, which was as large as a man's head, was situated on the right hip; the seventh, which was a small one, was situated below the right trochanter major; and the eighth, which is perhaps the largest on record, arose from the left hypochondrium, and hung down as low as the calf of the leg, being 2 feet long and 3 feet 1 inch in circumference, and weighed, when removed, 46 French pounds. In this country Sir Astley Cooper removed one that weighed 37 lbs. 10 ounces; and Mr. Liston one from the scrotum, which weighed 44½ lbs. The latter gentleman also mentions having removed one the size of an orange from under the tongue.

Sir Benjamin Brodie, so eminently distinguished in every branch of his profession, thus describes the intimate structure of the most common kind of these tumors. The fat resembles ordinary fat, except that it is rather of a more delicate, and of a looser texture, and of a lighter colour. It is composed of lobules with very thin membranes between them, and externally there is a thin membranous bag in which the whole mass is contained. "This bag has a very loose adhesion to the parts in which it is embedded, but the adeps which it encloses adheres pretty firmly to it." These tumors Sir B. Brodie has found to vary in some degree, according to the tissues in which they form, and instances the chronic mammary tumor as a probable variety. These tumors sometimes, though rarely, suppurate, and are seldom malignant in character. (*Med. Gazette.* Feb. 1844.)

Of Atrophy.—Some tissues undergo a spontaneous atrophy, as the umbilical vessels, the thymus gland, the sub-renal capsules, the right lobe of the liver, &c. These have their brief periods of existence and then wither away. In old age the lymphatic ganglia are no longer visible; the ovaries are reduced to a mere capsule; the parenchyma of the lungs is singularly rarified; the bones are of less density, and the brain lighter than in manhood. In disease, however, parts are sometimes greatly atrophied; thus a whole lung may be reduced to the size of the fist, one hemisphere of the brain may be greatly compressed and diminished, a kidney may disappear, the liver or the spleen be greatly reduced in size, and the walls of the heart so attenuated as readily to rupture. All parts of the body, therefore, are liable to be partially or generally atrophied. It is unnecessary to add, that such a loss of power must in all cases produce feebleness of action and disease. It is remarkable, that in health, if one set of muscles be greatly exercised, some other set is usually atrophied. Thus the muscles of the legs of dancers are generally powerfully developed, while those of the arms are soft and attenuated.

Such are the general laws of inflammation and of the non-malignant diseases of structure. It will now be necessary to give their causes, symptoms, and modes of treatment, as they occur in the different tissues and organs of the body, purposely omitting to describe these diseases, when occurring in the eye, or in the bones, as being by convention the more particular province of surgery, and also the diseases of the skin, as unintelligible to the general reader, without the assistance of a large and expensive series of plates.

Of Inflammation of the Dura Mater, and of other simple Organic Diseases of its Structure.

Remote Causes.—The principal causes which produce inflammation of the dura mater are diseases of the cranial bones, occasioned by mechanical accidents or the syphilitic poison, also the pressure of hydatids, or of a cancerous or other tumor of the brain. Rheumatic inflammation, or an extension of simple inflammation of the internal ear, as in otitis, are other classes of causes. In apoplexy, also, when blood is effused between the bones of the cranium and the dura mater, it is with difficulty absorbed, and becomes sometimes the cause of inflammation of that membrane.

Predisposing Causes.—Inflammation of the dura mater is extremely rare at any period of life; but as this disease results more usually from mechanical injuries or

from the syphilitic poison, the earlier periods of adult age are most liable to it.

Pathology.—The dura mater is subject to diffuse inflammation, perhaps to the serous, for water has once been found between this membrane and the cranium; and also to the adhesive, to the suppurative, and to the ulcerative inflammations, and these sometimes terminate in gangrene.

In diffuse inflammation of the dura mater the large vessels of this membrane are congested; but they are not so numerous as in most other tissues, and consequently the redness is not so general or so intense. In the acute forms of this inflammation the membrane readily separates from the bone; and, if rubbed between the fingers, the dura mater readily separates from the arachnoid; but in chronic inflammation these parts often adhere with great tenacity. This inflammation may terminate by resolution, or it may proceed, and lymph be effused. The adhesive inflammation is best seen in injuries of the head, when portions of the dura mater are often healed, or even reproduced to a considerable extent by this process.

Suppurative inflammation is still more common, and is a form of disease often seen in disease of the cranial bones. In other cases, also, when blood is effused between the cranium and dura mater, suppurative inflammation often ensues from irritation, caused by the effused fluid. The pus thus formed may make its way either externally or internally. In the former case a puffy tumor forms on the scalp, which, being divided, exposes a portion of the cranial bone, white and dry, and this, in favourable cases, exfoliates, and gives an exit to the pus. In the latter case the dura mater may ulcerate, and the pus be effused into the sac of the arachnoid. It is not uncommon, after severe injuries, for a portion of the dura mater to become gangrened.

Besides the chromatous inflammations which have been mentioned, the dura mater is occasionally the seat of achromatous inflammatiou. The formation of cartilaginous and bony deposits is an instance of this. These alterations are in general limited to a few points, seldom exceeding the size of a pea; but in other cases opposite layers shoot towards each other, of considerable length and size, converting the whole of the falciform process into bone.

The dura mater is also occasionally the seat of polypous tumors, pulpy to the touch, of a distinct fibrous structure, and which often acquire a considerable size, sometimes as big as a pullet's egg. These tumors are often pediculated, and resemble a mushroom, and by their pressure not only the bones and membranes are absorbed, but the brain may also be disorganized. Their seat is sometimes that portion of the dura mater which covers the petrous or other portion of the temporal bone; but more commonly they form under the superior portions of the cranium, which being absorbed they appear externally. These tumors have sometimes been seen ossified. Rostan mentions another tumor incident to the dura mater, and which he describes as an inextricable net-work of blood-vessels, or a true nævus, having an erectile disposition.

Symptoms.—The symptoms of acute inflammation of the dura mater are fever, pain in the head, great restlessness, and delirium. In some cases the other membranes of the brain become involved, and effusion takes place, causing coma or paralysis.

If the inflammation succeeds extravasation of blood, the symptoms are, first, those of compression, which partially or wholly disappear. Some time elapses before matter is formed, when fever and delirium succeed. If the patient recovers, the bones exfoliate, and the matter escapes. If, however, he falls, the fatal catastrophe is again preceded by coma, and symptoms generally of compression.

Ossification of the dura mater is sometimes unattended by any symptom. In Dr. Pemberton's case, however, it caused the severest form of tic-douloureux of the face. It has also given rise to epilepsy and to insanity. A case of this latter description occurred in a man who had been many times insane, and at last died of an abscess of the brain. On examination the falciform process of the dura mater was found ossified almost throughout its whole extent, while the arachnoid was as dense as the dura mater.

It is singular, says Rostan, that polypi, as long as they are contained within the cranium, seldom give rise to any symptom; and Louis, out of twenty cases that he quotes in his Memoir on this subject, says, that in two or three cases only was there any lesion of muscular motion, of the senses, or of the intellect. These tumors consequently can hardly be determined to exist until they make their way through the walls of the cranium. They are of variable size, and pulsate synchronously with the heart. This action may be stopped by compression, made either laterally or perpendicularly; but in the latter case the usual phenomena of cerebral compression, as loss of sense, convulsions, coma, or palsy, are brought on, but which disappear as soon as the finger is removed. In some instances the bone is rendered so thin by the process of absorption that, just prior to the eruption of the tumor, it gives a sound, when pressed upon, like the cracking of parchment.

Diagnosis.—When the cerebral symptoms are preceded by rheumatism, or are the result of the syphilitic poison, we may, without hesitation, affirm the seat of the disease to be the dura mater. When they arise from other causes, the other membranes are in general involved in the disease, and the symptoms are too complicated to allow of an accurate diagnosis.

Prognosis.—The prognosis in cases of syphilitic or of rheumatic affections of the dura mater is always favourable, however formidable the symptoms may appear. When the inflammation arises from mechanical causes, the brain having sustained an injury, the prognosis is in general less favourable.

Treatment.—The treatment of acute rheumatic inflammation, before effusion has taken place, is by bleeding and by mercury, so as to affect the mouth; and in cases of syphilis, by the iodide of potash. If matter forms, and the bone does not exfoliate, nothing but the happy temerity of the surgeon in trephining can in general save the patient.

The osseous depositions of the dura mater, unless capable of being removed by mercury or iodine, are at present beyond the powers of medicine. The treatment of the polypous formations is entirely surgical.

Of Arachnitis.

Remote Cause.—Arachnitis is a disease which most commonly occurs from the action of a morbid poison; and indeed there are few agents of that class which do not act on the membranes of the brain. There are many instances, also, of persons suffering from arachnitis after exposure to the heat of the summer's sun, or to

the "*coup de soleil.*" Intemperance, as well as great mental anxiety, is also a frequent cause of the chronic forms of the disease. Arachnitis is also especially connected with insanity, and with every structural disease of the brain; and to these causes must be added mechanical injuries.

Predisposing Causes.—Every age is liable to arachnitis. Children are often attacked by it whilst teething, under the form of hydrocephalus acutus, and also when labouring under scarlatina, measles, or other disease caused by a morbid poison. Adult age, as well as the middle periods of life, are still more liable to this affection, both from the greater exposure to the action of the typhoid and paludal poisons, to mechanical injuries, as well as to the greater intemperance and greater excitement incident to this age. In old people arachnitis is likewise common, more particularly from the ramollissement and other organic lesions of the brain, to which they are subjected. Both sexes perhaps suffer in nearly equal proportions from this affection.

Pathology.—The serous membranes of the brain are liable, with little exception, to all the forms of inflammation incident to serous membranes generally,—or to the diffuse, the serous, the adhesive, the suppurative, and the ulcerative; and these inflammations may be either acute or chronic.

In diffuse arachnitis the arachnoid has seldom any considerable redness or congestion, but is thickened and opaque; while the transparent serum naturally contained in the cavity of the arachnoid being now scanty, or wholly wanting, it has neither that polish nor that moisture which is natural to it in health, so that it appears brown and dry. The principal phenomena of arachnitis take place in the pia mater, so that the large vessels of that membrane are greatly congested; but still, according to Dr. Baillie, the redness is not so general or so continuous as in inflammation of other serous membranes. Also, if the pia mater be attempted to be removed, it is easily torn, and separates from the brain in small fragments. The arachnoid covering the dura mater seldom participates in this affection. These are the appearances observed in diffuse arachnitis, supposing it to terminate by resolution. The inflammation, however, often proceeds, and may now terminate by effusion of serum, lymph, or pus.

When serum is effused into the arachnoid cavity, the opacity of the arachnoid gives it a gelatiniform appearance; but when that membrane is divided it is found to be fluid, and to diffuse itself in every direction. Sometimes, however, the serum is found to be turbid, from an admixture of a small portion of free albumen. It is also not unusual to find a few points of lymph, of pus, or of blood, either at the exterior surface or in the cells of the arachnoid, effused along with the serum, and almost in juxtaposition with each other; so that every form of inflammation may co-exist at the same time in this membrane. The quantity of fluid effused is very variable, or from two to three drachms to as many ounces. The effusion most commonly takes place at the upper surface of the hemisphere, but sometimes at the base, and sometimes into the ventricles of the brain.

It is seldom that the inflammation is of greater intensity than has been mentioned, but occasionally it is so; and lymph is effused either into the *cavity* of the arachnoid, or into the arachnoid *sac*. Gendrin gives a case of a woman, aged 30, who, suddenly hearing of the death of her lover, lost her speech and her reason. After some months she so far recovered as to be sensible of her loss; but, although she shed no tears, she could speak of nothing else than their mutual affection. At length she relapsed and died; and, on opening the *sac*, it was impossible to distinguish the arachnoid, it being covered with a gelatiniform mass of loose lymph. Foville (*Art. Meningite*, p. 406, *Dict. de Médecine, &c.*) says he has met with six cases of this description, the effused lymph covering the whole of the brain, or nearly so, as far as the tentorium. The lymph was deposited in the arachnoid sac in two layers,—one adherent to the cranial arachnoid, and the other to the cerebral arachnoid; while between them was a stratum of serum, except in one case, where blood was effused. Foville mentions having had all these persons under his care for several years, and that they were all in a state of the dullest stupidity, and apparently labouring under paralysis of every sense. They were like statues, with this difference, that, placed upright, they preserved their balance; if pushed, they walked; and if food was placed in their mouths, they swallowed it.

When lymph is effused between the cranial and cerebral arachnoid, it is sometimes organized. Thus Rostan speaks of having found, in one of these cases, the cranial and cerebral arachnoids so thoroughly adherent as to form one mass, and Gendrin gives a similar instance of a woman of 70, who died comatose after a few days' illness.

Lymph also may be effused into the arachnoid cavity, but it is generally in small quantity, and is so seldom organized, that Louis states that he examined the brains of 200 bodies without finding a single instance. Rostan, however, is of opinion that in chronic inflammation of the cerebral arachnoid, the thickening is occasioned by the superposition of an organized false membrane, which, being detached, the original membrane recovers its primitive delicacy of texture, and almost its primitive transparency.

Suppurative inflammation may take place either into the arachnoid cavity or into the arachnoid sac. Rostan gives several cases of effusion of pus into the arachnoid cavity, and so does Morgagni, Cruveilhier, and Dr. Bright. Dr. Baillie states, he once saw pus effused into the cavity to such an amount as to cover the entire upper surface of the brain. Two cases are also given by Dr. Hodgkin of cut wounds of the head in which pus was found in the arachnoid sac.

The characters of chronic arachnitis are—a similar opacity and thickening of the membranes, together with granulations of a pearl colour, and more especially along the longitudinal sinus, and also an augmentation of the number of the glandulæ Pacchioni. Much serum is also effused into the cavity; and the cellular tissue by which the pia mater is attached to the brain acquires considerable strength, so that portions of the brain come away with the membranes. The surface of the brain is pale, and sometimes slightly atrophied. Ossification of the pia mater is extremely rare. Dr. Baillie, however, mentions one case, on the authority of Soëmmering; and Dr. Hodgkin speaks of a specimen in the museum of Guy's Hospital.

In acute arachnitis of the ventricles, the membrane becomes thickened, semi-transparent, pulpy, and sometimes sprinkled with minute spots of blood. It is rare to find lymph effused, but occasionally old adhesions are seen between the opposite surfaces of the ventricle. Pus has also been occasionally found in the ventricles, either

as a primary disease, or else in consequence of suppuration into the cavity of the spinal arachnoid. The surface of the ventricles also has occasionally been found sprinkled with points of scabrous matter, like particles of pounded glass, or rather resembling the gritty matter found in the pineal gland.

From the abundance and size of the vessels of the plexus choröides, it might be supposed that this part would be greatly liable to inflammation; but its diseases are chiefly chronic and achromatous, as small cysts, which sometimes give to the plexus the appearance of a bunch of currants; they have also been seen as big as a gooseberry, and even as a pullet's egg. The plexus is also liable to the formation of white opaque points, which may attain the size of a barberry. These are sometimes soft, and sometimes of a firm consistency, and are liable to become loaded with earthy matter.

Symptoms.—Arachnitis is usually divided into three stages. The symptoms of the first stage are those of excitement, resulting from diffuse inflammation; those of the second are those of compression, marking that effusion has taken place; while those of the third stage denote recovery or death.

The first stage is ushered in by fever, at first remittent, but which at length becomes continued; the patient complains of headache, of light and sound being painful, while the conjunctiva is red and injected; yet with this increased sensibility he is torpid and unwilling to be roused. At the end of a short period he rambles or becomes delirious, and in some cases violently so: at length effusion takes place, and the second stage commences with symptoms of compression of the brain; the eye and ear are no longer painful; the delirium, from being active, has changed to low and muttering; the pupil dilated, and the supply of nervous fluid so irregular, that the muscles are affected with subsultus tendinum. The sphincters of the bladder are often contracted or relaxed, so that the urine flows incessantly, or else is retained altogether. The sphincters of the rectum are also often relaxed, and the stools come away without the patient's consciousness. The last stage is that in which these symptoms gradually subside, and the patient recovers, or else be becomes comatose, and dies in a typhoid state.

The duration of these stages is very various. Sometimes each lasts a week; and this, perhaps, is most commonly the case, but one or more stages may be wanting.

The tongue, in the first stage, is white; in the second, it becomes brown; in the third, it again cleans, or the patient dies. The pulse likewise in the first stage is from 90 to 100; in the second, from 110 to 130; and in the last stage it either gradually returns to its natural standard, or else runs on too rapid and too feeble to be counted.

The symptoms which have been described are those which mark arachnitis at the superior portions of the brain. When, however, it occurs at the base, or in the ventricles, some differences are observable; for the intellect is less impaired, but the passions more excited, and the patient lies fretful, impatient, morose, and, although somnolescent, he occasionally cries out, grinds his teeth, while the parallelism of the axis of the eyes is frequently affected.

Such is the more usual course of arachnitis, but Dr. Watson has given two cases of arachnitis in children, one 9 years, and the other 2 years old, in which a yellow adventitious membrane was spread out between the arachnoid and pia mater. In the first of these cases the attack came on suddenly in the middle of the night, the girl screaming from violent headache, and exclaiming somebody had given her a blow on the head. The other was equally suddenly attacked one morning with long and severe convulsions. They both appeared to have died comatose, the one on the sixth day, and the other on the fourth.

Chronic meningitis may exist *per se*, or may succeed to the acute form, and the symptoms of this affection are very various. One patient had no other symptom for some months than headache and paraplegia of the upper extremities, when he fell into a typhoid state and died. Often insanity is the first symptom; and this is followed first by the speech becoming affected, and then by hemiplegia, and this perhaps by apoplexy. The duration of this affection is from a few weeks to many months. The cases recorded by Foville of the statue-like character of the patients, when effusion of lymph has taken place into the arachnoid sac, are too few in number to allow us to consider the connexion between those symptoms and that peculiar form of disease as established; but should they ultimately prove so, it will be a curious problem to determine the probable cause of so complete an annihilation of the intellect.

Diagnosis.—Arachnitis is distinguished from encephalitis by the headache, the early delirium, and by the general absence of hemiplegia. It must be admitted, however, that disease of the brain, and of its membranes, is often conjoined, so that arachnitis is not in all cases a simple affection.

Prognosis.—Six cases of arachnitis out of seven are supposed to recover in fever. When it depends on mechanical injuries, the prognosis is more unfavourable; and should it become chronic, the ultimate result is often fatal.

Treatment.—The treatment of arachnitis, when arising from morbid poisons, will be mentioned under the head of the diseases caused by those agents. As a general principle, however, remedies have little influence over those forms of the disease. When arachnitis arises from mechanical injuries, the treatment is by bleeding, calomel, active purgatives, and by cold applications to the head. In chronic cases of insanity, Foville strongly recommends the cold *douche*, but with caution, as being a powerful depressant, yet producing less ultimate debility than bleeding. He seems to think it acts by cooling down the general mass of the blood, and producing a salutary general re-action. He quotes the experiment of Harvey, who, having passed a ligature round his arm, so as to stop the circulation, put the lower part of the limb into cold water; when that was sensibly cooled down, he removed the ligature, and speaks of having felt the cold blood flowing along the arm, &c., till it reached the heart, and gave the sensation of coldness in that organ.

The dietetic treatment should be strictly antiphlogistical, and the patient should likewise avoid all mental excitement; and indeed, if not secluded, should be kept tranquil not only in body but also in mind.

Of Encephalitis, or Inflammation of the Substance of the Brain, and of other simple organic Diseases of its Structure.

Inflammation of the brain was a disease little known to the ancients, and even much still remains to be done in elucidation of this important subject. The writers who have most contributed to remove the difficulties con-

nected with this interesting inquiry are Morgagni, Rostan, Lallemand, Bouillaud, and Abercrombie. 2368 cases are reported to have died of cephalitis in England and Wales in 1839.

Remote Cause.—Inflammation of the substance of the brain is caused by every morbid poison that produces fever. Many cases also result from mechanical injuries, others from the excitement of insanity and uncontrolled moral feelings. In some instances encephalitis has followed the suppression of a cutaneous eruption, in others caries of the bones of the cranium, and especially of the petrous portion of the temporal bone caused by otitis. Intemperance also is a frequent cause of this as well as of every other disease of the brain. As a secondary disease, encephalitis is produced by cancer, tubercle, and by every other structural disease incident to this organ.

Predisposing Causes.—Encephalitis occurs at every age: in childhood during the tendency to hydrocephalus; in adult age from the action of morbid poisons, and from mechanical and moral accidents; and in old age from the natural decay of the frame. If we assume ramollissement of the brain to be a form of encephalitis, that disease has occurred at the following ages, or in a few cases from birth to 15; thirty-nine cases occurred from 15 to 40; fifty-four cases from 40 to 65; and sixty cases from 65 to 87. The frequency of this disease, therefore, increases with age. Men are supposed to suffer in a larger proportion than women from this disease, and probably from their greater exposure to the exciting causes.

Pathology.—The inflammations of the substance of the brain have much that is peculiar. In a small number of instances they are chromatous, but in by far the greater number of cases they are *achromatous* or colourless. Taking both classes, the brain may be said to labour under the diffuse, the serous, the adhesive, the suppurative, and the gangrenous inflammations.

The red *diffuse* or chromatous inflammation of the substance of the brain appears to have many degrees. In the first degree the substance of the brain, when cut into, exhibits more bloody points than usual, so that the medullary substance appears as if sprinkled with blood, while the colour of the cortical substance is increased in intensity. If the inflammation assumes a higher degree, it only partially affects the brain, as one of the convolutions, or a small portion of a hemisphere; and the inflamed part now varies from a bright rose to a deep red colour. This increase of colour is supposed by many pathologists not to arise from any greater vascularity of the part, but from blood escaping from the vessels and becoming effused or infiltrated into the substance of the brain, forming, according to Boyer, so many apoplectic *foyers*. The inflamed part is generally swollen, and sometimes considerably so, and is generally softer, though sometimes firmer than usual.

The most common form, however, of inflammation is for the most part achromatous, and is termed *ramollissement* of the brain, and appears to be a variety of serous inflammation modified by peculiarity of texture. The characteristic of the part affected is, that it is generally whiter or greyer than the natural colour of the brain, and also softer than the natural substance of the brain. This softening has many degrees, and in its extreme form the brain is absolutely diffluent, so that it can be poured out of the cranium with as much facility as a thickened cream or a thin jelly can be poured from one cup into another. In this semi-liquid state much serum can often be expressed from it. This disease may be acute or chronic, and the following instances will show that its causes are those which produce inflammation in other parts of the body, and also that its course is similar.

Paroisse (*Opuscules de Chirurgie.* Paris, 1806) states that he examined the brain of twelve persons who died between the nineteenth and twenty-second days, after the loss of a considerable portion of the cranium from sabre wounds. Each wound was as large as the palm of the hand; and a considerable portion of the dura mater, as well as of the brain, had been cut off with the abscinded portion of the cranium. The most remarkable pathological phenomena in these cases was a great diminution in the size of the brain, and its extreme *softness.* There was no water in the ventricles, and the dura mater was dry. The arachnoid was strongly adherent to the brain, and in some instances appeared to have been partly destroyed by suppuration. In some cases there was little or no moisture in the substance of the brain, so that it appeared dried up.

Mr. Stanley gives two cases of hernia cerebri, in one of which, after excision of the protruded portion, "the protruded brain lost its natural colour, and acquired a light yellow appearance, was split into several portions, and often exhaled from it an exceedingly fœtid odour. Its substance daily became *softer*, ultimately acquiring an almost *semi-fluid* state, and in this state the whole mass wasted away. As the dead and putrid brain was detached fresh granulations rose to fill the vacancy, just as we see them arising from any surface from which a dead part has been separated by the natural processes."

In another case in which, after the excision of a portion of the brain, the brain again protruded, and acquired the size of a hen's egg. On examination after death, the protruded portion was in some parts *softened*, and had red particles of blood intermixed with it, while "all the medullary structure intervening between the base of the protruded part and the anterior corner of the lateral ventricle had entirely lost its natural structure, and had become *soft* and *pulpy*, so as to convey the idea of rottenness. Around this disorganized mass, and extending across the corpus callosum into the medullary substance, forming the roof of the opposite ventricle, the brain had undergone a change from its natural colour to a greyish-blue-white, while it still retained its natural consistency. It is remarkable that in this case during the last three days we noticed a very considerable quantity of fluid constantly oozing from the centre of the protrusion, whence it trickled down the cheek in a continued stream." Mr. Stanley conceives this fluid came from the lateral ventricles; although, from the soft and rotten state of the brain, he admits "we were not able to discover any distinct channel of communication between them."

In the cases that have been narrated, the injuries were most severe, and the termination fatal in a few days, so that no doubt can exist of the acute character of the ramollissement; and yet the pathological phenomenon in all was *softening*, without any red discoloration, thus rendering it highly probable, if not strictly demonstrating, that the softening must be the result of an achromatous inflammation. Another proof, also, of the inflammatory nature of ramollissement is afforded by Dr. Carswell, who states he has found the vessels of the part obliterated and indurated, traversing the diseased portion like so many small wires.

The forms of ramollissement may be chronic as well

as acute, and these are also achromatous. It is singular how large a portion of the brain may be affected with this chronic disease, as a whole hemisphere, and sometimes the entire mass of the brain. The consistency of the diseased part varies, as in the acute form, from cream to a thin jelly, or probably according to the quantity of serum it contains. It is strange that when most diffluent it is still compatible with many of the functions of the mind.

Dr. Sims (*Med. and Chir. Trans.* vol. xix. p. 413) is of opinion that ramollissement is capable of being cured, and that the evidence of this fact is the disappearance of one or more layers of the cortical substance, as he supposes, by absorption, while the pia mater adheres to this part of the brain. The evidence of the cure of ramollissement in the grey matter of the corpora striata and other central parts, is the presence of a number of "holes," resembling, he says, Parmesan cheese, of a red colour, when there has been transudation from the blood-vessels, and of a fawn-colour in other cases. The part, he says, is also atrophied and softened; while the holes may be filled with a limpid fluid, sometimes lined with a membrane.

The next of the achromatous inflammations of the substance of the brain is that state in which, instead of being softened and diffluent, the brain becomes harder than natural, and acquires the consistency of white of egg boiled hard, or of well made *jaune mange.* M. Dance (*Répertoire Général d'Anatomie et de Physiologie*, 1828) gives the case of a patient who received a blow on the head about seven months before his death. He afterwards suffered from epistaxis, and severe and frequent paroxysms of headache. At length he fell down in walking from the bath, and died convulsed in about a quarter of an hour. On inspecting the brain the convolutions were flattened; there was very little blood, and no serous fluid in the encephalon; but all the substance of the brain resembled white of egg boiled hard. Its weight and density were considerable, and it yielded and recovered its form like an elastic body. There was no trace of a red vessel, so that the cortical substance was paler, and the medullary substance whiter, than usual. This may be considered as the result of adhesive inflammation; and that adhesive inflammation is a property of the brain is certain, from the formation of cysts, and of the union of divided parts by cicatrization.

The next form of inflammation is the suppurative; and the suppurative inflammation may be either acute or chronic. Most authors have supposed it may be of two kinds, or that the pus may be collected into an *abscess*, or else be *infiltrated* through the substance of the brain. This inflammation may perhaps be chromatous, but in the far greater number of cases it is achromatous, no trace of redness being seen in any part of the brain.

Abscess of the brain, then, is generally strictly achromatous, the surrounding substance of the brain being of the natural colour, except in a very few cases in which it succeeds to apoplectic effusion, when the walls of the cavities are dyed by the previously extravasated blood. Dr. Baillie says, when the abscess is of large size the weight of the pus breaks down the neighbouring parts, and they look simply as if they had been destroyed, or very much injured by the pressure; and also when the abscesses are small, there is an ulcerated appearance of the cavity in which the pus is contained. In other cases the usual membrane of an abscess forms. This membrane is at first extremely delicate, and easily torn; but as the disease advances it becomes of greater consistency, and even of considerable density, so that in some cases it is fibrous, fibro-cartilaginous, and even ossified, and is thus one of the causes of the formation of bony tumors of the brain. The patient seldom perhaps survives the formation of an abscess; but it is apprehended that the pus may be occasionally absorbed, and that the opposite walls may unite by granulations, and leave a cellular cicatrix. The size of the abscess is very various, being sometimes hardly bigger than a pin's head, and then again as large as a pullet's egg. When large they are seldom more in number than one; but when small there are sometimes several. The pus contained in them is often good laudable pus, but in other cases it is serous, and contains portions of lymph or albumen.

Infiltration of pus or purulent ramollissement is apprehended to exist when the brain is softened, and the diseased part of a yellow or cream colour. That this state of parts is owing to purulent effusion is a fact inferred rather than proved, and consequently this doctrine requires much further investigation before it can be considered as established.

Besides these forms of inflammation, Mr. Stanley has shown that in his cases of hernia of the brain, portions of the brain have *sloughed* away, have *granulated*, and have passed into a state of gangrene; showing that this organ, so singular in its structure, is possessed of every power of inflammation known to exist in other parts.

The pathology of the cerebellum, whether acute or chronic, is in every respect, as far as is at present known, similar to that of the brain.

It is impossible to give the relative frequency of these different forms of inflammation of the substance of the brain; but the red punctuated state of the brain is the most common, then the serous or ramollescent state, while all the other forms are infrequent. If we take ramollescence of the brain as the most striking instance of its disorganization, we find it does not affect all parts of the brain equally, for out of 171 cases there was,—

	Cases.
Ramollissement of the whole of both hemispheres in	4
one hemisphere in its whole extent	13
single convolutions	14
convolutions and deeper-seated parts	9
anterior lobes	27
middles lobes	37
posterior lobes	16
corpora striata	28
thalami opticorum	15
walls of the ventricles	2
crus cerebri	1
various parts	5
	171

The two hemispheres of the brain suffer from ramollissement with nearly equal frequency, or out of 169 cases the right hemisphere was affected in seventy-three cases, the left in sixty-three, and both in thirty-three instances.

Ramollissement of the cerebellum is much more rare than of the brain, and Andral states that, up to 1833, only thirteen cases of this affection had been recorded.

In eight of these the disease was limited to one of the lateral lobes. In four, both lobes were affected; and in the last case there was an isolated ramollissement of the median lobe. In four of these cases the brain was concomitantly diseased, in another the mesocephale, and in another the spinal cord.

Encysted or other tumors have sometimes been found in the substance of the brain. Dr. Sims gives a remarkable case of this in a woman aged 48, who had hemiplegia of the left side for three years. In this case more than half of the substance of the right hemisphere was found to be wanting, and its place occupied by fluid contained in a membrane. The substance of the brain forming the walls of the cavity was fawn-coloured, and soft like jelly.* Hydatids are also sometimes found in the substance of the brain, and, according to Cruveilhier, the cysticercus is more common than the acephalocyst. Bony tumors are sometimes met with, and most commonly consist of an irregular mass, formed by bony processes, with a fleshy substance filling up the interstices; and of this sort of tumor, Dr. Baillie says there are several examples in Dr. Hunter's museum.

Otto, in his *Compendium of Pathological Anatomy*, translated by Mr. South, remarks that *hypertrophy* of the brain is especially produced in rickets, and in rare cases may occur even before birth; "that it frequently occurs at birth when the brain sometimes attains a very large size. I have twice seen this to such an extent," he adds, "that the elasticity of the brain thrust up the calvaria at certain points, by bursting asunder slight sutures." Mr. Sweatman relates the case of premature development of the brain in a child 2 years old, in which this organ weighed 2 lb. 15½ ounces avoirdupois, the average weight being, at this period of life, 2 lb. 1 to 2 ounces. Dr. Sims gives a case of a man whose brain weighed 3 lb. 9 ounces, the average weight being under 3 lb. In a girl 10 years old the brain weighed 3 lb. 12 ounces, the average weight being about 2 lb. 10 or 11 ounces. Otto thinks it may be a mode of cure of hydrocephalus, the ventricles having been expanded by fluid at some former period; while Andral thinks that repeated hyperæmia of the brain may be one cause among others of hypertrophy of the brain.

The brain is sometimes found *atrophied*. In a woman that died apoplectic, the brain weighed only 2 lb. 4 ounces, being 6½ ounces less than the average weight of the brain at that age. The brain of a child two years old, that died of pneumonia, was weighed the same day, and was 2 lb. 3 ounces. Atrophy of the brain is for the most part a congenital disease; but it also appears to be a disease incident to old age; for the weight of the brain at 50 averages 2 lb. $14\frac{8}{29}$ ounces, while at 70 and upwards it only averages 2 lb. $4\frac{3}{14}$ ounces.

The great physiological question connected with this portion of the subject is, whether the different parts of the brain, which have been observed to be the seat of the different lesions which have been mentioned, have demonstrated the phrenology of the present day, and shown the seats of the different faculties, either of mind or of motion. Andral has compared the different seats of lesion affected with ramollissement, but has found no constant connexion between the part affected and the mental disorder; and he thinks that the existence or absence of the disordered functions of the mind in cases of ramollissement depends much less on the seat of the alteration than on the sympathetic affection which exists between the softened part and the rest of the encephalon.

Symptoms.—Diffuse inflammation of the substance of the brain arises very generally, if not constantly, as a consequence or as a concomitant of arachnitis; and the symptoms are consequently identical,—as fever, headache, the senses pained by their natural stimulants, delirium, subsultus, coma, resolution of the sphincters, and death.

The symptoms of *Ramollissement* of the brain have probably a considerable latitude. In the twelve cases related by M. Paroisse, and resulting from wounds, he states that the symptoms were nearly the same in all, and were as follows:—The men all stated that after the wound they had felt no other inconvenience than local pain of the injured part, and that for two or three days afterwards they had all been able to march five or six leagues a day. On the third day, however, they had all been seized with fever, which terminated on the evening of the fourth day; but from that period they had suffered little, always preserved a good appetite, and prayed not to be put on a low diet. About the seventeenth day they became downcast and dejected, owing, probably, to many sloughs being detached, and much suppuration taking place about this time. On the following day they first lost the sense of smell, and then the senses of sight and taste. With these symptoms, but without fever or convulsions, they fell into an easy sleep; and, as if they had no further strength to contend with the disorder, they died between the nineteenth and twenty-second days from the infliction of the wound.

The symptoms which have been related by Paroisse agree entirely with those observed by John Hunter. That skilful surgeon observed that trifling wounds of the membranes of the brain were often followed by severe and extensive inflammation of those tissues, and by very dangerous symptoms; but if the injury had been great so as to have excised not only a portion of the arachnoid, but also of the substance of the brain, that the symptoms which followed were comparatively slight—a circumstance which he attributed to the brain in the latter case having room for expansion; and he therefore suggested the propriety of extensively lacerating the arachnoid and pia mater in all cases in which the dura mater alone had been wounded.

Idiopathic ramollissement may be acute or chronic, and its attack may be sudden, or preceded by some preliminary symptoms, as headache, or long-continued derangement of the digestive organs.

In whichever way the disease forms, the severity of its attacks are sometimes as formidable and as overwhelming as a fit of apoplexy. The patient falls down in a similar state of insensibility, and his limbs are similarly palsied. There is often no difference between apoplexy and ramollissement in the fit, but there are striking differences after recovery from the fit. On recovering from apoplexy, for example, the patient has some degree of intelligence; but after a severe attack of ramollissement, the mind is impaired and delirious. A woman, about fifty, had suffered from ill-health, but not by any headache, giddiness, or other cerebral symptom, when on a sudden she was seized as in apoplexy, and on recovering at the end of a few hours was hemiplegic, delirious, and did not know the persons about her. Bleeding and other antiphlogistic treatment appeared rather to aggravate the symptoms; and in a few days she experienced

* *Med. Chir.*, vol. xix.

a second attack, after which she lay without speech or motion, and died in a typhoid state. In this case the left ventricle, on being opened, presented the appearance of an ulcerated surface, being very loose in texture, or in a state of ramollissement resembling curds and whey, except in some portions of it, which resembled a rotten apple.

In some instances the attack commences without the fit, but in almost as sudden a manner. A gentleman, whose health had been so good that he had dined out only a day or two before, found, on getting into bed, that his leg failed him. He rang the bell, but when the family reached the room, his mind was so far gone that he mistook the persons about him. As his head was evidently affected, some leeches were applied to his temples; but while they were drawing, his arm dropped, and in a few hours he fell into a typhoid state, with a brown tongue, so that it was necessary to support him with some glasses of claret daily. He at length recovered, and lived several years, but the hemiplegia remained.

In another case of a gentleman who had long suffered from derangement of the digestive organs, with a white tongue, and also with headache, the first symptom of the brain being structurally affected was, that on attempting to walk he found himself moving in a small circle around his room, and had no ability to walk straightforwards owing to a want of power in his right side. The paralytic symptoms increased, and in a remarkable manner, so that the pupil of one eye was dilated, and the other contracted: one side of the face was exceedingly sensible, while the other had lost all sensation. The right arm was palsied, while the left was numbed, and the left leg was palsied, while the right leg was benumbed. Every attempt to bleed this patient was followed by syncope, and he at last recovered by wine and tonics.

The cases that have been related are, perhaps, fair specimens of the acute attacks of ramollissement of the brain. In the chronic forms of the disease the course is slower, and Rostan divides it into two stages.

The first stage, preceded perhaps by headache, or by derangement of the digestive organs, commences by the patient complaining of vertigo, numbness, of a pricking of the arm or leg, and often of confused vision. In addition to these disordered perceptions, the judgment, the memory, or other faculty of the mind, is more or less affected, and the patient falls into a sort of senile *dementia*. His speech also is often affected, his answers slow and hesitating, and he has great disposition to sleep. In the midst of this overthrow of the functions of the brain, the functions of organic life present no remarkable alteration, except that in some cases the tongue is white, micturition difficult, the pulse slow, and the appetite voracious.

The second stage is marked by decided palsy,—the use of a limb or of one side of the body being lost, sometimes suddenly and sometimes gradually. The speech is also more and more affected, so that the patient with difficulty makes himself understood. His tongue now becomes brown, his pulse rapid, and he lies in a typhoid comatose state, from which he rarely recovers. In some instances contraction of the limb occurs instead of relaxation, the extensors being palsied while the flexors still retain their full powers. Convulsions, also, of one or both sides of the body may take place in the course of the disease.

Palsy, it has been stated, not only affects the muscles, but impairs also the sensations of the limbs. Still in some cases the sensibility of the skin, instead of being lost or deadened, is singularly increased, so that the patient screams out if touched, or subjected to the slightest pressure; and this sensation of extreme pain, though frequently limited to one limb, yet sometimes extends over the whole body. Some patients compare it to the pricking of a thousand needles; others to the sensation of a burn, and which the slightest attempt to bend the limb renders insupportable.

The pulse is so little affected in chronic ramollissement of the brain, that in 97 cases out of 126 taken by Andral, he has not noticed its frequency; but it is occasionally something slower, and occasionally more frequent than in health.

The duration of life in ramollissement of the brain is very various, but in 109 cases the disease terminated in the following times,—

1	died in	12	hours	7	died in	6	days	3	died in	15	days	1	died in	25	days	1	died in	65	days
1	,,	15	,,	8	,,	7	,,	1	,,	16	,,	1	,,	29	,,	1	,,	68	,,
1	,,	24	,,	8	,,	8	,,	2	,,	17	,,	4	,,	30	,,	1	,,	190	,,
1	,,	32	,,	3	,,	9	,,	4	,,	18	,,	1	,,	35	,,	1	,,	220	,,
5	,,	2	days	5	,,	10	,,	5	,,	20	,,	1	,,	36	,,	1	,,	5	months
9	,,	3	,,	4	,,	11	,,	3	,,	21	,,	1	,,	47	,,	2	,,	6	,,
5	,,	4	,,	2	,,	12	,,	1	,,	22	,,	1	,,	49	,,	1	,,	1	year
4	,,	5	,,	3	,,	13	,,	1	,,	23	,,	1	,,	60	,,	2	,,	3	,,

The inference deducible from this table, is, that ramollissement of the brain is more frequently an acute than a chronic disease, the greatest number dying before the 12th day, while at the end of a month only 16 cases out of the 109 were living.

In the 13 cases which have been collected of ramollissement of the *cerebellum*, the lesions of intellect were trifling, while motion was greatly affected in all except one doubtful case, or in 10 there was palsy with or without contraction of the muscles of the opposite side of the body; in two others convulsive actions of both sides of the body, and in the last case which was observed by Rostan, the palsy was on the same side. In this case the disease depended on an exostosis of the petrous portion of the temporal bone. In no instance is any sexual desire recorded to have troubled the patient.

Induration of the brain is of rare occurrence, and its symptoms can hardly be said to be yet determined. In a case related by M. Dance,* the man received a blow on his head about seven months before his death; he afterwards suffered from epistaxis, and severe and frequent paroxysms of the headache. He fell down while walking from the bath, and died convulsed in about a quarter of an hour. Another case was that of a child,

* *Répertoire Général d'Anatomie et de Physiologie,* 1828.

brought to St. Bartholomew's Hospital in a state of insensibility, which lay for a week without motion or consciousness, and then died. The whole brain was as hard as the white of a boiled egg; but nothing could be learnt of the previous history. The brain of the celebrated Pascal was found to be indurated, and he died not only with hallucinations, but also labouring under a species of religious monomania.

The symptoms of abscess of the brain are likewise extremely obscure. In a case treated for disease of the nose, the man made no complaint of his head, and was able to sit up in bed, and to assist himself in every way, when he died suddenly in the night. To the surprise of everybody, an abscess of considerable size was found in the left hemisphere above the ventricle. In other cases, according to Dr. Baillie, pain, delirium, coma, and palsy are the symptoms observed.

The symptoms of hydatids of the brain are often very obscure. The slowness with which they form probably often causes the brain to become accustomed to their presence, and consequently they do not give rise to any very prominent symptom; Cruveilhier gives a plate of a hydatid occupying the internal surface of the right hemisphere, immediately above the corpus callosum, and which caused no cerebral symptoms. Dr. Baillie also gives a case in which a serous cyst, as large as a gooseberry, pressed on the optic nerves at their junction, and yet the pupils were not dilated, nor the eye-sight impaired till within a day or two of the patient's death. In other cases they cause severe headache, palsy, loss of sight, or of other sense, and also absorption of the bones of the cranium, coma, and death.

Atrophy of the brain is usually congenital, or the consequence of some severe hydrocephalic disease, and the parties suffering are generally idiotic, and possess but little use of their limbs. Andral gives a singular case in which the patient, a girl, though an idiot, was able to do little errands in the neighbouring villages, and lived to an early adult age, yet when examined after death was found to have no trace of cerebellum.

Hypertrophy of the brain is usually connected with hydrocephalus, or is probably caused by some inflammatory action. These persons seldom possess much power of intellect, but their faculties generally are less impaired than in cases of atrophy.

Diagnosis.—The great difficulty in the diagnosis of acute ramollissement is to distinguish it from apoplexy. The diagnostic symptom most marked, however, is the early delirium and hallucinations of the senses, occuring before the brain has time after the fit to become inflamed, a circumstance which does not ordinarily take place till four to ten days after the attack.

Prognosis.—The prognosis in every case of encephalitis is grave; but, as far as we can judge, even acute cases do recover, and live many years afterwards.

Treatment.—In diffuse inflammation of the brain arising from mechanical injuries, there can be no doubt that bleeding and the antiphlogistic treatment generally are most beneficial when employed with a wise discretion. When, however, the same inflammation depends on the action of a morbid poison, it is necessary to warn the inexperienced practitioner that such measures must be employed with the greatest caution, and in most cases are better omitted altogether; for we find in many cases of typhus fever, in which the brain is probably partially softened, that the patient recovers under a powerful stimulant treatment.

In idiopathic ramollissement of the brain, the treatment can hardly be said to be yet determined; but there is good reason to suppose that bleeding is injurious, and that most advantage is derived from the use of tonics, and of a nutritive diet. "If it was demonstrated," says Andral, "that ramollissement of the brain, was a form of inflammation, the therapeutic indications would be easy, for we should only have to apportion the antiphlogistic treatment to the strength of the patient; but so far from this treatment being successful, abundant depletion has been followed by a notable augmentation of the cerebral affection." Indeed every practitioner must often have observed, that when the brain has been softened, every attempt to relieve the patient by bleeding has not only entirely failed, but the fits of apoplexy have returned, or the hemiplegia has been increased. On the contrary, when the acute cases have been supported with wine, &c., these have sometimes recovered, though mutilated. Again, in the more chronic and fatal forms of the disease life is evidently prolonged by mild tonics, attention to the bowels, and by a liberal and nutritious diet. Beyond this the medical treatment of ramollissement of the brain is still a problem, with only a few unsure data to guide us for its solution. Little has been done to determine the treatment of induration, of suppuration, or of the other forms of cerebral disease that have been mentioned.

Of Inflammation of the Membranes of the Spinal Cord.

Remote Causes.—The membranes of the cord, unlike those of the brain, are little acted upon by morbid poisons. The most frequent remote causes of inflammation of these tissues are, exposure to cold or wet, mechanical injuries, caries of the vertebræ, and perhaps diseases originating in the substance of the cord itself.

Predisposing Causes.—This class of disease is incident to every age, but is most common in childhood and in adult age.

Pathology.—The chromatous inflammations of the membranes of the cord are the same as those of the membranes of the brain,—or the diffuse, the serous, the adhesive, the suppurative, the ulcerative, and the gangrenous.

The rachidian dura mater may be inflamed either at its free or at its adherent surface. On examining the spinal canal, after tetanus or caries of the vertebræ, the cellular tissue uniting the dura mater to the walls of this cavity is often found greatly loaded with venous blood; and in some instances is broken down, so that the dura mater is entirely detached; which two circumstances being conjoined distinctly show this state of parts to be the result of inflammation, and not of congestion. This inflammation may terminate by resolution, or it may proceed, and serum be effused, as in two cases reported by Bergamaschi, in which he found that fluid poured out between the osseous structure and the dura mater. The adherent surface also is liable to the adhesive inflammation; for in the case of William Banks, who died in St. George's Hospital, on the 64th day after a fall from a scaffold 40 feet high, the fourth dorsal vertebra was not only found fractured, but there was a slight effusion of blood and *lymph* between the osseous part of the spinal canal and the dura mater. In another instance in which there was caries of the 8th, 9th, and 10th dorsal vertebræ, the adherent surface was not only

injected and red, but contained a matter which appeared to be pus.

Besides the diffuse, the serous, the adhesive, and the suppurative inflammations, the dura mater appears liable to the ulcerative and to the gangrenous inflammations. In a case given by Ollivier,* of a druggist who died on the twentieth day after suffering from lumbar pains, with rigidity of the trunk and lower extremities, together with tetanic spasms, there was found, on cutting through the muscles of the lumbar region, half an ounce of pus, or more, which was traced to the cavity of the arachnoid, the rachidian dura mater having ulcerated and ruptured. The following case is an instance of gangrene of the dura mater of the cord:—A man, while carrying a heavy load on his back, fell, and fractured the ninth and tenth dorsal vertebræ. The operation of trephining the fractured parts was performed by Mr. Tyrrel, in St. Thomas's Hospital. The man, however, died on the fifteenth day, and the portion of the dura mater which had been exposed by the operation was black, and similar to that of parts threatened with gangrene. In another case, also, a young woman, aged 27, was knocked down in the Rue Montmartre by an old woman falling upon her, out of a five-pair-of-stairs window in the delirium of fever, and had the fourth dorsal vertebra fractured. This patient lingered till the forty-ninth day, when, on opening the spinal canal, the dura mater at the injured part was found to be soft, easily torn, and black.

The dura mater of the rachidian canal is also liable to some achromatous inflammations. In a rachitic patient, 60 years old, only four feet high, and who had never been able to walk without crutches on account of a remarkable bandiness of his legs and thighs, there was found, besides other lesions, caries of the second cervical vertebra, and also several osseous depositions, as well as thickening of the dura mater, at the diseased part.

The spinal *arachnoid* and *pia mater* are liable to all the chromatous inflammations of the corresponding membranes of the brain, as the diffuse, the serous, the adhesive, the suppurative, and the ulcerative.

Diffuse inflammation of all the folds of the arachnoid has often been observed, those membranes being red and injected for a greater or less extent, till in some instances it has occupied nearly the whole length of the spinal canal; and it is probable, although the opportunities of examining the spinal cord are comparatively rare, that the membrane is not only red but dry.

Effusion of serum, both into the cavity and into the sac of the spinal arachnoid, is not uncommon. Lymph is more rarely effused, yet has occasionally been found organized, uniting the opposite sides of the sac together. The pia mater and the arachnoid have also been found adherent after effusion of lymph into the cavity; and instances have occurred in which all the layers of the spinal membranes have been found united to each other.

Suppurative inflammation of the spinal membranes also occasionally takes place. This form of inflammation, according to Ollivier, only occurs in the cavity of the arachnoid—" toujours l'exsudation puriforme est sous-jacente à l'arachnoide." This physician gives as an instance, the case of François Sabatier, aged 28, who, without any known cause, was seized with dorsal pains, lassitude, and weakness in all his limbs, and, as the disease advanced, with tetanic opisthotonos, which returned at irregular intervals. He died on the ninth day, and on examining the spinal canal the arachnoid *cavity* throughout its whole extent was filled with pus. The same author gives other similar cases, and finds that the suppurative inflammation usually co-exists with the adhesive inflammation.

Besides the chromatous inflammations the membranes of the cord are occasionally the seat of achromatous inflammation, whence result bony and cartilaginous formations. These deposits vary in size from a pin's head to patches of five or six lines in diameter, seldom exceeding in thickness a melon-seed; and this thickness, as in the melon-seed, diminishes from the centre to the circumference. They are sometimes exceedingly numerous, and sometimes cover nearly the whole extent of the membrane. Andral has met with them external to the dura mater, and as large as peas. Ollivier says they are formed on the rachidian arachnoid, while Dr. Sharpey and Dr. Hodgkin affirm they are formed between its layers.

Symptoms.—The symptoms of rachidian arachnitis are often obscure at the commencement, but the disease once formed, pains of the back, with affection of the muscles, and retention of urine, are the pathognomic signs of the disease.

A greater or less degree of pain of the back, proceeding from the point of greatest intensity of inflammation, is one of the most prominent symptoms. It may be limited to one vertebra, or may extend along the whole of the spine, and even down the thighs. Sometimes it is continued, sometimes intermittent, and in either case it may be of uniform intensity or else darting. Occasionally it is so severe as to cause the patient to shriek out. In one case the patient was so harassed that he could not lie down, but kept walking about the room in a state of extreme agitation, grasping the lower part of his back with his hands through the intensity of the pain; he had no interval of ease, and was sometimes incoherent and unmanageable. He died, and pus was found in the spinal arachnoid cavity.

The affection of the muscles varies from simple stiffness of the part to opisthotonos. This latter symptom is often limited to the neck or trunk, without the limbs participating, as in a case given by Rayer, in which the trunk and neck were drawn backwards, while the patient walked freely till the time of his death. In the case of a waggoner thrown off his cart and pitched on his neck and shoulders; the neck was stiff, the jaw was locked, the body convulsed, and the patient delirious. It was not till the twelfth day, however, that the lower extremities became affected and palsied, when the patient sunk into a typhoid state and died. A large quantity of pus was likewise found in the spinal arachnoid cavity in this case.

Neither the pulse nor the tongue are much affected at the commencement of this affection, but towards its close the one becomes rapid and feeble, and the other brown and dry, and the teeth fuliginous; the patient's state is now typhoid, and he dies delirious or comatose.

Retention of urine generally persists from the beginning to the termination of the disease. Constipation often exists to a great degree at first, but afterwards the bowels act regularly, or even suffer from diarrhœa.

The duration of this affection is very various; in acute spinal arachnitis life is seldom preserved beyond a fortnight or three weeks; but if the case be slight the pa-

* Vol. ii. p. 569.

tient often recovers in six weeks or two months; while in chronic cases, if the disease be of a character to terminate unfavourably, the period may be much longer.

Diagnosis.—The symptoms which distinguish spinal arachnitis from inflammation of the substance of the cord are *pain* and *contraction* or *convulsions* of the limbs; for in pure myelitis there is seldom any severe or constant pain, while the limbs are generally palsied and their sensations benumbed or lost. It is distinguished from rheumatic lumbago or psoas abscess by the affection of the limbs and of the bladder.

Prognosis.—Many authorities consider spinal arachnitis to be incurable, but many cases marked by the characteristic symptoms in a mild form do recover.

Treatment.—Spinal arachnitis, seldom depending on a morbid poison, is perhaps, in all cases, best treated by bleeding and mild purgatives. General bleeding is sometimes necessary; but local bleeding, either by cupping or leeches, along the vertebral column, is most useful, and perhaps cannot be omitted with safety. The medical treatment consists in moderate purging by the neutral salts, as the sulphate of soda or the sulphate of magnesia; for as these act on the bladder as well as on the bowels, they are probably the best medicines. Whatever purgative, however, may be selected, it will be proper to continue it with the tinct. hyoscyami or other mild opiate, to procure the patient some relief from his sufferings. Mercury, it should be stated, is not supposed to exert that power in meningitis of the cord which it possesses over inflammation of serous membranes generally. The warm bath is an excellent adjuvant in the early stages of the disease; whilst in the latter stages blisters, setons, moxæ, or the ungentum antimonii tarlarizati are more beneficial, or at least as a last resource are deserving a trial.

An abstinence from all animal diet should be imperiously prescribed throughout the whole course of the disease.

Of Myelitis, or Inflammation of the Substance of the Spinal Cord.

Remote Cause.—The substance of the cord is acted upon by a very small number of poisons, and, consequently, the most common causes of disease of this portion of the nervous system are accidental violence, as blows or falls. Affections of the cord, however, sometimes occur idiopathically, and the constitutional causes producing it are exceedingly undetermined. Vogel considers them to be often owing to a suppression of the menses in the female, and to the suppression of a hæmorrhoidal flux in the male, while others attribute them to sitting in damp or wet clothes. Caries of the bones must also be an occasional cause.

Predisposing Causes.—No age, perhaps, is exempt from myelitis, but it occurs more frequently from ten years old and upwards. It is most common, however, in adult age, and more frequently attacks the male than the female sex.

Pathology.—As the spinal cord is a continuation of the brain, and similarly composed of medullary and cineritious matter, it is reasonable to expect its diseases will be similar, and such is the case. The chromatous inflammation of the cord is limited to the diffuse inflammation, which is characterized by a few more bloody points than usual, or else by a slight red or rose-colour suffusion. Dr. Budd mentions a case in which a man fell to the bottom of a barge, fracturing the third, fourth, and fifth cervical vertebræ. He died seven days after the accident, and there was found opposite the fourth cervical vertebra a portion of cord which felt soft, and on being divided it was found converted into a red semi-fluid pulp. The membranes were sound.

The most common affection, however, of the spinal cord is the *achromatous* ramollissement or serous inflammation. In this form of disease the substance of the cord is greatly broken down and softened, so as to be sometimes reduced to a mere pulp. Ollivier mentions a case in which it was so diffluent as to give the sensation of fluctuation under the finger. This disorganization sometimes embraces the whole thickness of the cord, sometimes only one of its columns, so that it is of very variable extent. It is constant, however, that the centre or *grey* substance of the cord is more softened than that of the circumference or white substance. The ramollissement may exist in the cervical, dorsal, or lumbar portions of the spine; but it is most common in the lumbar, and after that in the cervical portions, or in those parts which contain the greatest quantity of *grey* substance, and, consequently, the greatest number of blood-vessels. The part affected is generally swollen, a circumstance more striking than in similar diseases of the brain, because the spinal canal is large in proportion to its contents, compared with the cranium. The softened part is also generally ash-coloured or white.

Some pathologists have regarded ramollissement of the cord as a particular alteration of the nervous system, as resembling the effects of a contusion of soft parts, and the result of the shock. It often occurs, however, when no shock has been received, and has not the least resemblance to a contusion of soft parts; and as this singular state of parts is produced in the brain by morbid poisons, the admitted causes of inflammation, as well as accidents, there seems no hypothesis so satisfactory as that which attributes it to the result of an achromatous inflammation.

Induration of the spinal substance is another result of achromatous myelitis, and is probably a further stage of inflammation, corresponding to the adhesive inflammation. Portal states he has found the cord of a cartilaginous hardness, while the membranes were red and inflamed; and Abercrombie gives a similar case.

The substance of the cord may likewise fall into suppurative inflammation; and some authorities conceive that the pus may be infiltrated, as well as collected into an abscess. The fact of infiltration is perhaps questionable, but there can be no doubt of an abscess having occasionally formed in the substance of the cord. Velpeau,* indeed, gives a case in which an abscess was formed in the right column of the cervical portion of the cord, three inches long and two lines broad, while a smaller one existed also in the left column. This form of the disease is also void of colour, and is achromatous.

Gangrene of the cord has been seen, but is extremely rare.

In some cases the spinal cord has been observed hypertrophied, either in its whole extent or partially. In the former case it fills the whole cavity, and is exactly applied to the walls of the osseous canal. Laënnec has observed this hypertrophy in all the extent of the cord; Andral has seen it limited to the cervical region of an epileptic child, and Hutin has given a case

* *Revue Méd. Franç. et Etrang.*, vol. ii. p. 217.

Elementary Principles of Medicine.

in which this hypertrophy existed from the occipital foramen to the middle of the dorsal region.

Atrophy of the cord is more rare than of the brain, but it sometimes exists, and it may be general or partial. Ollivier has twice seen this atrophy in all the extent of the cord. In one case it was reduced to one-half its usual size, and in the other it was one-third less. Magendie has seen a third case, in which the cord was not only diminished in size, but also indurated.

Of partial atrophy of the cord, M. Ollivier has seen a case in which the cord was so contracted at the last dorsal vertebra that it did not exceed three and a half lines from side to side, and little more than two lines from back to front. In another case of caries of the vertebræ, all the white substance had disappeared, and exposed the central grey substance. In another, the cord at the lumbar region was reduced to the size of a goose quill. Sometimes partial atrophy of the cord has been caused by the pressure of hydatids, or from a dislocation or other diseased state of the atlas or dentatus, or from a contracted occipital foramen.

Some few instances of ramollissement have been observed, limited to the anterior or posterior columns of the cord, but they have not supported Sir Charles Bell's doctrine of the former being the exclusive agents of motion, and the latter of sensation.

Symptoms.—The symptoms of myelitis are in general limited to the parts below the injury. In a few cases, however, the accidents are reflected from below upwards. In general both upper or both lower limbs are affected; but in a few instances only one limb. The first symptom is numbness, with a sensation of coldness down the limb. Shortly afterwards the patient complains of pain in the back, corresponding to the seat of greatest intensity of the inflammation; but this is not constant, for pain is often absent, even when we make pressure with the finger over the spinous processes of the affected part. These symptoms are succeeded by impaired motion, and often likewise of sensation of one or more limbs; and this is followed by paraplegia, or other form of palsy. The palsied limbs may be either relaxed or permanently contracted: thus the hand may be bent on the upper arm, or a leg be flexed upon the thigh; or the affected limb may be attacked with convulsive twitchings, or else may beat incessantly the devil's tattoo. As the disease advances the bladder becomes affected, and the patient is either incapable of retaining his urine, from the sphincters being palsied, or else it is suppressed from their permanent contraction. The action of the bowels is slow in the first instance; but towards the close of the disease the patient is often purged, and the stools pass involuntarily. If the disease be the result of an accident, the pulse is at first rapid and full; but if it be spontaneous the pulse is generally natural, until the powers of life are broken down by the continuance of the affection. As the scene draws towards its close, the nates and the prominent parts of the pelvic region, on which the body rests, ulcerate extensively, so that deep sloughs form, and although the patient, from anæsthesia, suffers no pain, he nevertheless ultimately sinks exhausted.

In injuries of the spine, from wounds and contusions, some differences in the symptoms have been observed, according to the seat of the injury. It is well known, for example, if the spinal cord be lacerated or divided above the origin of the phrenic nerves, or above the third cervical vertebra, death is the immediate consequence, the nervous influence being no longer transmitted to the diaphragm and other muscles of respiration. Petit gives two remarkable instances of this. The only son of a working man went into the shop of a neighbour, who, in play, raised the child from the ground by putting one hand under his chin, and the other at the back of his head. The child, only six or seven years old, struggled, dislocated his head, and died immediately. The father coming in at that instant, and transported with anger, threw a saddler's knife at the man, and lodged the cutting part in the back of his neck, and this man died within an hour. There are a few cases, however, in which disease of these parts has not been immediately fatal. Thus the odontoid process has been destroyed by caries, or the second cervical vertebra has been dislocated, and yet the patient has continued to live for some months, or even some years. A remarkable case of a diminished area of the occipital foramen, whence resulted great pressure on the cord, was met with by Mr. Holberton,* and yet the patient lived more than two years, the most remarkable symptom being an extremely low pulse. In these chronic cases the formation of the disease is slow, so that the cord becomes accustomed to the gradually increasing pressure, and the respiration consequently still continues to be carried on principally, though feebly, by the muscles of the neck and shoulders, the diaphragm and intercostal muscles being more or less palsied.

When the injury, however, is below the origin of the phrenic nerves, or at the level of the fifth and sixth cervical vertebræ, the inspiration is free, but the expiration is laborious, for the intercostal and abdominal muscles are paralyzed and incapable of assisting in that process. The patient can yawn, for that is an act accompanied by inspiration; but he cannot sneeze, for that is an act accompanied by expiration. At this point, also, the upper extremities are still palsied, both as relates to motion and to sensation. When the palsy of motion and of sensation is complete, the patient, says Sir Benjamin Brodie, during the short remaining period of his life, presents the extraordinary phenomenon of a living head, with its sensibility and muscular powers unimpaired, attached to a trunk and extremities of whose existence he is only conscious by the sense of sight. Another very common symptom connected with injuries of the upper portion of the cord is priapism. This affection shows itself about the second or third day after the accident, and generally subsides after the first fortnight. It sometimes occurs even when all sensation in the part itself is destroyed, so that the patient is not sensible even when the catheter is introduced.

If the injury be in the situation of the sixth and seventh cervical vertebræ, the palsy of motion and of sensation is frequently imperfect of the upper extremities, while it is complete in the trunk and lower extremities.

When the spinal cord has been injured in the part corresponding to the first dorsal vertebra, the upper extremities may still suffer from an incomplete palsy either of motion or of sensation, or both. When, however, the seat of the lesion is in a line with the second dorsal vertebra, the sensation and motion of the upper extremities remain unimpaired, but the respiration is still difficult from the palsy of the intercostal and abdominal muscles.

The symptoms, when the injury is in the lumbar

* *Med. Chir. Trans.* vol. xxiv. p. 180.

region, are not dissimilar to that of the dorsal region, except that the respiration is unaffected. Dupuytren has remarked, also, when the lumbar region is the seat of the disease, that the sound introduced into the bladder is more frequently covered with incrustations, and that the patient also more commonly suffers from ulceration of the nates; but these symptoms perhaps result only in consequence of the patient surviving for a longer period than when the superior portions of the cord are affected.

In chronic affections of the cord the palsied limbs usually waste and become atrophied.

In cases in which a limb has suffered from palsy, both of sensation and of motion, some singular phenomena have been observed; or that when a stimulus has been applied to the palsied limb, it often occasions involuntary contraction of the muscles of that limb. Thus, when a feather is passed lightly over the hollow of the foot, as in tickling, convulsions occur in the limb although the patient is quite unconscious that anything is touching his foot. These movements also are quite independent of volition, and vary in extent and force inversely with the degree of voluntary power possessed by the affected limb, being most forcible when the loss of voluntary power is most complete, and diminishes gradually in extent and force as that power is increased. In some instances, by irritating one leg, movements were caused not only in that leg, but also in the other leg; and similar phenomena have been observed by Sir G. Blane and others, in decapitated animals, showing even a portion of the cord may furnish a supply of nervous energy after disease has interrupted its connexion with the brain.

Diagnosis.—Diseases of the spinal cord, and diseases of the brain, are often followed by nearly similar symptoms; and consequently the one seat may be confounded with the other. But the history of the case, or whether it has or has not been preceded by a fit of apoplexy or of epilepsy, will often enable us to determine the particular seat of the disorder. Myelitis is distinguished from lumbago, psoas abscess, and hip disease by the absence of pain, and by the existence of the palsy.

Another point of diagnosis is, can we determine from the symptoms whether the cord or the membranes be the seat of the disease? Baglivi and Pallisio trephined the spine in the dorsal regions of many dogs. These animals did not appear to suffer when the knife pierced the substance of the cord; but if the dura mater alone was pricked, they fell into convulsions. The same phenomena appear in many cases to follow in the human subject, namely, that when the cord alone is diseased, the patient suffers no pain; while on the contrary, when the membranes are diseased, he often suffers most severe pain, with convulsive motions of the limbs.

Prognosis.—It is certain that many cases of severe contusion of the spine do recover, although it seems probable some organic lesion must have taken place. There seems likewise no reason to doubt that as many perfectly recover from superficial inflammatory lesions of the brain after fever, so also that many slight inflammatory affections of the substance of the cord may subside, and the patient do well. Many cases, indeed, even when the bladder is slightly affected, do recover. If, however, the disease be of more than a few weeks' continuance the prognosis is always grave. Still some few do recover, the leg being withered. But more commonly the disease runs on, and the patient at length falls after a long struggle.

Treatment.—In classing ramollissement of the cord with inflammation, it might appear necessarily to infer that the treatment should be strictly antiphlogistical. It is questionable, however, whether this mode is at any time advantageous; and it may be laid down as a general rule, that bleeding ought not to be had recourse to after palsy has occurred. Previous to that symptom it may be admissible; but, even then, it sometimes happens that the symptoms are aggravated almost as soon as the blood flows. After the palsy has manifested itself, bleeding is plainly improper; for, the nervous influence being intercepted, the powers of the lower part of the body are so reduced that it readily runs into gangrene, a tendency which loss of blood greatly increases. "It is a great mistake," says Sir Benjamin Brodie, "to think blood-letting always proper." "I have no reason to think blood-letting arrests softening."

As bleeding rather aggravates than amends the symptoms, the greater number of chances of saving the patient rest on our acting on the alimentary canal so as to produce three or four motions in the 24 hours, and thus creating such a derivation as in some degree to relieve the parts: at least the greater number of patients that do recover are restored by these means. The purgative is not perhaps important; but as the neutral salts act not only on the intestines, but also on the bladder, that class of remedies is generally preferred. At the same time that the bowels are kept free, the patient should be allowed a liberal supply of wine, or from six to eight ounces daily, and should be indulged in animal food at least once a day. If these means fail, and the disease proceed, we have no specific remedy. Some physicians have recommended small doses of the tinct. of cantharides, but the result has been anything but satisfactory. Of the untried medicines perhaps the secale cornutum is of the greatest promise.

With respect to local applications, as blisters, moxas, or setons, they are possible remedies, but the tendency to gangrene renders their application of doubtful utility. When had recourse to, however, it would perhaps be better to apply them above the seat of the disease than immediately over it, the greater vitality of the superior parts giving us greater assurance of our being able to heal them.

Of Inflammation and other Simple Organic Diseases of Structure of the Alimentary Canal.

The mouth, the great adit to the alimentary canal, is often inflamed. The mucous membrane of the tongue, the gums, and of the cheek and lips, is liable to inflammation and ulceration from a variety of causes, as sharp corners of the teeth, or rugged tartar on their external surfaces. These affections are seldom of much moment; and simple ulcers may be readily made to heal by abstracting the exciting causes, and the application of some astringent wash, or of some mild ointment. Ulceration of the mouth, also, when produced by mercury, even supposing the tongue to protrude, for the most part readily heals on leaving off the use of the medicine. In some few cases, however, the inflammation thus produced does not readily subside, and the salivation continues, the ulceration extends, portions of the jaw exfoliate, and in a few cases death results. In these severe cases it is necessary to support the patient by wine and sago, and by quina, or other tonic medicine, and also to wash the mouth frequently with an acid gargle, or with a solution of the chlorides.

Besides these affections, the bones of the palate sometimes exfoliate, an affection most commonly the result of the syphilitic poison. The mucous membrane of the antrum maxillare is occasionally inflamed, when the symptoms are a violent throbbing pain in the part affected, in the temples, and in the teeth. The side of the face is likewise swelled from infiltration of all the soft parts, and the Schneiderian membrane of the corresponding nostril is generally red and swollen. If the disease terminates in suppuration, and no exit for the pus exists, enlargement of the cavity takes place, so that the ossa malæ project, or the orbit of the eye is thrust upwards. The mucous membrane also lining the antrum becomes thickened, when the small aperture by which the antrum and nostril communicate is closed, and no outlet left for the accumulating fluid. If the disease be not interfered with, the matter most usually makes its way by ulceration into the socket of a decayed tooth, or the anterior parietes is absorbed, and it now flows by the nose, by the side of the canine or small molar teeth, greatly annoying the patient by its fœtor and by the slowness with which the abscess is emptied. This affection, unless it is prevented forming by bleeding, fomentations, and by purging, falls in the latter stage entirely into the hands of the surgeon. There are likewise some other minor diseases of the mouth, as gum-boils, serous cysts, ranulæ, and the occlusion of the salivary ducts by calcareous deposits, but these also are surgical. The diseases of that part of the mouth termed the throat will be treated of under the head of the respiratory organs, as more intimately connected with the symptoms of disease of those parts. There are, however, two diseases of the mouth of sufficient importance to attract the attention of the physician, as the various forms of stomatis termed aphthæ.

Of Aphthæ, or Inflammation of the Mucous Membrane of the Mouth. (*Thrush.*)

1019 cases are reported to have died of thrush in 1839, in England and Wales.

Remote Cause.—The remote causes of this affection are very various. It sometimes arises from mere derangement of the stomach and bowels, but more commonly from general debility; it is also the concomitant of the latter stages of almost every severe disease. Besides these causes, some peculiar states of the atmosphere appear to engender it, for it is epidemic in some years and hardly known in others. Thus Billard states, that out of 917 healthy children 228 were attacked in 1826; and, according to Valleix, out of 657 healthy children 140 were attacked in 1834, and 99 died. When epidemic, it appears to have a *contagious* property; for, according to Burns, a healthy child sucking the breast immediately after a diseased child, has taken the infection. M. Taupin says he has seen it communicated to a healthy child drinking out of the same glass, or eating with the same spoon, after an infected child. This physician also says, that at the Hôpital des Enfans it appears almost always as an epidemic.

Predisposing Causes.—This class of disease is extremely common in childhood, so that, according to Burns, every child has at some period or other an attack. In the adult, however, it is extremely rare as an idiopathic affection; but it is occasionally met with as a result of severe disease, as phthisis. Taking all the forms of this affection, M. Taupin says he has observed them in one case in twenty in children, and but only in one case out of 1900 sick adults. It is more frequent in boys than in girls. The most common age is while suckling, or during the two periods of dentition.

Pathology.—These inflammations of the mucous membrane of the mouth are of three kinds,—the characteristic of the first being an exudation of points of lymph of the size of a pin's head, or larger, over the surface generally of the mucous membrane of the cheeks, tongue, and gums; the second is marked by a thickening of the epithelium, with points of ulceration of that membrane, the base of the ulcer being the denuded tongue, &c., red and sore to the touch. These two forms of aphthæ are seldom idiopathic, but are most commonly only seen in the last flickerings of the lamp of life, and when the patient is wasted by long and chronic disease. The third variety is when the ulcer, though similarly situated, affects the deeper-seated tissues as well as the epithelium, and often occurs in children in the best health. This disease is termed the *thrush*, and we shall now limit our observations to this affection.

Aphthæ, or the *thrush*, consists of a number of small ulcers of the mucous membrane of the mouth, with edges either elevated or *à pic*, and with a greyish base. Authors have allotted to these a great number of different seats, as the epithelium, the mucous follicles, and the substance of the mucous membrane itself; but it is probable all these parts may be affected. They have also admitted two principal varieties of this affection, or aphthæ simplices, and aphthæ contagiosæ, the one being contagious, the other not so; but this difference of property is certainly not very clearly proved.

Aphthæ simplices are characterized by a number of little white transparent vesicles, which shortly rupture, leaving a small *round* white ulcer, surrounded by a reddish areola. The course of this disease is not determined, but it varies from a few days to two, three, or four weeks, and is supposed to be kept up by a succession of crops. This form of disease is found to exist in the pharynx, œsophagus, stomach, small and large intestines, and also about the anus.

The aphthæ contagiosæ differ little from the preceding, except that the ulcers are of an irregular oblong, and in size and shape about that of a barleycorn. They usually affect the edges of the tongue, the sides of the frænum, the outside of the gums, and the interior of the cheek; but in no instance has it been observed that these ulcers extend to the pharynx, or other part of the alimentary or respiratory canals. The course of these ulcers is not well determined; but sometimes they disappear in a week, while in other cases they will last for a month or six weeks; the same ulcers either continuing, or else being renewed by a succession of crops. This affection is usually accompanied by an abundant salivation, and sometimes by an enlargement of the glands of the neck. In this form of aphthæ, likewise, the poison appears to have an ultimate action ou the parenchymatous substance of the lungs, terminating in a loose spongy hepatization.

Symptoms.—Some local pain and heat of the mouth, some difficulty in swallowing or suckling, with an alteration in the timbre of the voice; also some slight febrile re-action, causing the child to be fretful, are the principal symptoms marking aphthæ simplices.

The symptoms of thrush, or of aphthæ contagiosæ, are fever, which sometimes causes the child to be drowsy, oppressed, and hot for some hours to two or

three days before the aphthæ appear. The ulceration established, the fever proceeds, often accompanied by much delirium and subsultus tendinum. The stomach and bowels also are much deranged, the stools green and acrid, so as to excoriate the rectum, and cause much pain. The pulse also is quick, and the tongue, though white at first, often becomes brown and dry; and these symptoms continue for two, three, or four weeks, when the child recovers, or else, perhaps, from some secondary action on the lungs, he ultimately sinks.

Treatment.—The treatment of aphthæ simplices depends on restoring the disordered bowels or other parts that may be diseased to their usual healthy actions; but it is necessary to add, that this treatment should be tonic, at least as far as the case admits of; and of tonics the infusi aurantii c. tinct. aurantii, are among the best for children. A small quantity of wine, mixed with three parts of water, may also be given once or twice a day.

The treatment of the aphthæ contagiosæ, or thrush, even when there is much fever and delirium, is also best treated on the tonic principle, and especially by small quantities of wine, together with attention to the bowels. Some practitioners add to this a local treatment of the borate of soda, mixed with honey, applied to the ulcers; others wash the mouth with infusion of roses, or else with a solution of zinc or other lotion; but these applications are not important. The treatment of the pneumonia, which sometimes follows this affection, is not determined. The little patient's diet should be slops, sago, arrow-root, broths, and light puddings.

Of Inflammation and of other Simple Diseases of Structure of the Mucous Membrane of the Œsophagus.

Œsophagitis—is an inflammation of the mucous membrane of the œsophagus.

Remote Cause.—Inflammation of the œsophagus is a rare disease, for the morbid poisons have little influence over this portion of the alimentary canal, and the general causes, as they are termed, as atmospheric vicissitudes, are in like manner seldom followed by inflammatory affections of this part. The most frequent causes of inflammation of the œsophagus are children accidentally drinking boiling water out of the spout of a tea-kettle; swallowing corrosive liquids, as the mineral acids; and wounds most commonly inflicted in the act of committing suicide.

Predisposing Causes.—Children a few days old are sometimes affected with slight inflammatory affections of the œsophagus; and such few other cases as do occur may probably take place at every period of life.

Pathology.—The mucous membrane of the œsophagus is liable to the diffuse, to the adhesive, to the ulcerative, and to the gangrenous inflammations; but no instance is known of its being the seat of serous or of suppurative inflammation, without breach of surface.

Diffuse inflammation of the mucous membrane of the œsophagus is characterized by a deep redness of the part affected, generally terminating by resolution, but occasionally followed by separation of the cuticle. If the disease proceeds, lymph is thrown out. In new-born children points of lymph are often found lying on the mucous membrane of the œsophagus, being apparently an extension of the thrush affecting the mouth and pharynx. Andral has once seen in a girl twelve years old lymph thrown out after the manner of broad bands in the pharynx, œsophagus, and stomach. After puberty this form of inflammation is still more rare, but there are some few instances. Cruveilhier says that he found among the preparations of Dupuytren a very remarkable example of inflammation of the œsophagus, terminating in the formation of a false membrane, which coated this canal throughout its whole length. Dr. Abercrombie also gives the case of a gentleman, aged twenty-six, who caught cold and died in about three weeks. The whole of the pharynx was covered by a loose adventitious membrane, which also extended over the epiglottis, and portions of it were found lying in small irregular masses within the larynx, at the upper part. A similar membrane was traced through the whole extent of the inner surface of the œsophagus, quite to the cardiac orifice.

Besides lymph being thrown out, the mucous membrane of the œsophagus may also ulcerate. Dr. Wilson, of the Middlesex Hospital, gives the case of a young woman, aged twenty-one, who had swallowed, as she supposed, about a table-spoonful of oil of vitriol. This patient survived forty-five weeks and three days. The œsophagus for the lower two-thirds was thickened and narrowed, and the seat of an irregular cicatrix, showing that an ulcer had existed and had healed.

These ulcers, in general, form on the anterior portion of the œsophagus, and by continued extension they at last penetrate the posterior surface of the larynx, so that the patient often dies suffocated from the escape of food into the lungs. Occasionally the ulceration takes place from without inwards. A lady took cold, as she imagined, by riding in her carriage with the window down. Much difficulty of swallowing ensued, and the probang could not be passed into the stomach. At the end of a few weeks she was seized with a sudden vomiting, and threw up a large quantity of matter, after which she rapidly recovered. There can be no doubt that an abscess had formed in the submucous tissue, which burst into the œsophagus. Mr. Travers has also given a case of a deep-seated tumor found on the right side of the trachea, which opened at length into the œsophagus, and the patient passed pus both by the mouth and anus. Wilmer has given the case of a patient who was wounded in the mouth by a small sword. An abscess formed, which opened internally into the œsophagus, and externally in the neck, and the pus which escaped was often mixed with alimentary matters. The part became *gangrened*—the carotid was laid bare—and the patient died.

Dilatation.—The œsophagus may be partially or generally dilated. Dr. Hanny (*Edin. Med. Surg. Jour.* vol. lx. p. 66,) gives a case of general dilatation in a young man aged thirty, who had suffered from dysphagia, and in whom the œsophagus was found dilated to the size of a child's arm, measuring six inches in circumference. The walls were thickened, but without ulceration or carcinomatous deposit. Instances of partial dilatation of the œsophagus are much more common, and very constantly exist when the cardiac orifice is obstructed, or the seat of cancerous deposit. In general there is only one pouch, capable perhaps of containing a large portion of an ordinary dinner; but in a few instances the dilatation is multiplex; and an instance of this is given by M. Roennow of a young person who suffered much from offensive breath, and in whom the œsophagus was found, after death, dilated into several cavities, containing the remains of aliment in a putrid state.

Stricture of the œsophagus is occasionally met with,

and it may be partial or general. In cases of poisoning with the mineral acids, the whole œsophageal canal is found constricted and narrowed; the mucous membrane puckered up and contracted so as greatly to diminish the calibre of the canal generally. More commonly the stricture is partial; one circular muscular fibre perhaps having abnormally contracted, and in this state been bound down by adhesive inflammation, diminishing the diameter of the canal at that part to at least one-half. Dr. Baillie mentions a case in which from this cause the diameter of the œsophagus was so reduced as hardly to allow a garden pea to pass, yet in all other respects the œsophagus was healthy. The party had laboured for many years under a difficulty of swallowing, and could only pass substances of an extremely minute size into the stomach. A beautiful specimen of this description is to be found in the museum of St. Thomas's Hospital.

Ramollissement.—Guersent and Bouillaud have given several cases of rupture of the œsophagus in consequence of ramollissement. The following instance is related by Boerhaave. The Baron Wassonmaer, of an excellent constitution, but subject to the gout, had contracted the habit of taking an emetic after every excess at table, which with him was not infrequent. One evening, after a copious repast, his emetic not producing its usual effect, he made some efforts to assist it; all at once, however, he shrieked out, threw himself on the ground, and complained of atrocious pain, and of having felt something burst at the superior portion of his stomach. He died in eighteen hours. On opening the chest, the lung on the left side was found swimming in a fluid similar to that contained in the stomach. This fluid was traced to a transverse rupture of the œsophagus, without any trace of ulcer or erosion, and through which the fluid had made its way into the left cavity of the chest.

Induration.—Dr. Baillie is of opinion that induration of the œsophagus seldom or never exists, except as the first stage of cancer of this organ. Some writers, however, state that they have seen the œsophagus surrounded with a cartilaginous ring, and in one case that it was actually converted into bone.

Polypi.—Polypi of the œsophagus are much more rare than of the larynx. Graaëf, Schneider, Pringle, Monro, and others, have all, however, seen this disease.

Schneider says that at the autopsy of a woman, aged fifty-four, and who died of dysphagia, he found three polypous tumors in the œsophagus. These tumors were from an inch to an inch and a half long, and two of them adhered to the mucous membrane by a thin pedicle, while the third was attached by a broad base. In substance they were fleshy, except the pedicles, which were firm and white. The case given by Monro is one of great interest, as the tumor was made out during life, and successfully removed by a ligature. It is as follows:—

James Davison, aged 68 years, was admitted into the hospital for a polypus of the œsophagus. On examining the throat nothing extraordinary was discovered, but on irritating the pharynx till the man vomited, a long fleshy excrescence was thrown up, which filled the mouth and almost reached to the teeth. It had four heads growing from the same stem, and now so pressed upon the larynx that it could not be retained in the mouth longer than a minute without danger of suffocating the patient. For many years it had rendered deglutition difficult, respiration less free, speech less distinct, and produced frequent fits of coughing, by which it was forced upwards into the mouth. In a consultation, it was determined to remove it, first performing tracheotomy in order that the patient might breathe, and then by passing a ligature round the excrescence. This plan entirely succeeded, and a great part of the tumor separated and came away in the stools. Two years afterwards the patient returned to the hospital out of health and emaciated, not having been able for some months to take scarcely any solid or liquid food. He shortly after died, when the œsophagus was found to be distended by a large fleshy polypus, which grew from the anterior surface about three inches below the glottis, single at its base and divided into two heads, of which the largest and longest reached almost to the stomach.

Symptoms.—The symptoms of œsophagitis are almost entirely local, and consist principally of pain, of dysphagia, of the expectoration of a thick viscid mucus, and perhaps vomiting; emaciation follows the loss of nutrition, and the patient ultimately falls from inanition. Dilatation of the œsophagus is marked by nearly the same symptoms. Stricture of this canal may be determined by the introduction of a probang. In ramollissement of this part the patient, except perhaps suffering from indigestion, is generally in tolerable health till the rupture takes place, and then the aliment being effused into the cavity of the chest, he dies from pleuritis or asphyxia. The symptoms of induration without cancerous deposit are not determined. The existence of a polypous tumor can only be determined with certainty when it is high enough to be visible.

Diagnosis.—The diseases with which it may be confounded are similar states of the stomach; and the diagnosis in these cases is often difficult and perplexing. Stricture may be confounded with the spasmodic affections caused by an irritated state of the lung or trachea.

Prognosis.—Simple œsophagitis is probably often recovered from, as is seen after wounds of the throat partially dividing the œsophagus. The chronic forms of inflammation of the œsophagus probably often lay the foundation of the ultimate death of the patient. Ulceration extending into the thoracic cavity is in all cases fatal.

Treatment.—The treatment of œsophagitis is by small local bleedings, by warm cataplasms to the neck, and by moderately acting on the bowels. In the treatment of the more chronic forms some opiate is essential. The use of the probang must be left to the discretion of the practitioner; but it may be remarked, that there are few cases in which it can be really useful, for in dilatation and in stricture of this canal there is an equal danger of rupturing the canal and causing an ulcer. When the case is hopeless from the small quantity of aliment which reaches the stomach, life may yet be prolonged by enemata of broths, milk, egg wine, or other nutritious fluid matters.

Of Gastritis.

Gastritis—is an inflammation of the mucous membrane of the stomach.

Remote Cause.—Gastritis is often the consequence of the action of morbid poisons, especially of the typhoid and paludal poisons, or of the poison of the hooping-cough. It is also very constantly the result of many other poisons, as arsenic, corrosive sublimate, or oxalic

acid. This disease, however, is extremely rare from the action of general causes, for in the whole of the Peninsular war not more than six cases are reported among the troops, exposed as they were to every species of privation, and in civil life Louis opened 500 bodies without finding a single instance. Indeed, the difficulty of exciting acute inflammation in the stomach will be seen in the long escape of the polyphagist, who swallows knives and watches, and all sorts of heterogeneous things; and of the Indian, who passed many times daily a blunt sword into his stomach with impunity, till at last he pierced its coats and died. The stomach, also, we find, will bear tea or coffee of an almost boiling temperature, followed perhaps shortly afterwards by a quantity of ice. One of the persons resident at the Eddystone light-house at the time it was burnt, swallowed a quantity of molten lead when looking from below upwards to observe the progress of the fire. But even after this intensely hot substance had passed into his stomach, he lived several days. His attendants hardly believed his story possible, but on examining him after death a lump of lead weighing some ounces was taken from the stomach.

Predisposing Causes.—The few cases of simple gastritis that occur have been met with for the most part in adults.

Pathology.—The mucous membrane of the stomach is liable to the diffuse, the adhesive, and the ulcerative inflammations, and these may be either acute or chronic.

The pathognomic characters of acute red diffuse inflammation of the mucous membrane of the stomach are redness, increased thickness, and diminished cohesion, so that much larger portions of it can be removed by the handle of the scalpel than in health. The redness may consist of a few points, or it may be arborescent, or striated, or in patches of greater or less size, or it may occupy the whole surface of the stomach. The colour of the inflamed part is of a deep venous red, approaching to black; and if it be seen or represented of a lighter hue, this result has probably been produced by exposure to the air, which in a few seconds changes the venous tint into a bright scarlet. The seat of the redness is sometimes the villosities, sometimes the web of the membrane, and sometimes also the subjacent cellular tissue, which is often injected, and the seat of extensive ecchymosis. The parts most frequently inflamed are the cardiac or pyloric orifices, the fundus, the convexity of the folds, and sometimes the whole stomach. In chronic red diffuse inflammation there is the same deep venous colour, the same thickening, but the cohesion of the gastric mucous membrane to the subjacent tissue is increased. There is a great tendency also for the deep venous colour, as it subsides, to become changed to a rusty brown, or else to a slate colour.

The adhesive inflammation, or throwing out of lymph at the surface of the mucous membrane of the stomach, is a rare disease. Billard says he has met with it three times in the stomachs of children that have died of thrush; and Andral once saw it in the stomach of a child 12 years old. There is a specimen of this kind to be seen in the museum of St. Thomas's Hospital.

The mucous membrane of the stomach is often the seat of ulcerative inflammation. In some cases the ulcer is a mere erosion, but more commonly it has a distinct edge, generally sharp, as if cut by a punch, and again it may be depressed, shelving off into the muscular coat. In some few instances the edge is elevated and thickened. The *base* of the ulcer is the mucous, the muscular, or the serous coat; and in extreme cases the latter ruptures. It sometimes happens, however, that when the mucous membrane is ulcerated, the serous coat adheres to the surrounding parts, or to the walls of the abdomen; and in the latter case, if the ulceration proceeds, an artificial anus, as it is termed, may be formed, the food escaping externally; or it may adhere to the colon, and the food escape into that canal. Ulceration sometimes takes place from without inwards, as well as from within outwards; thus an abscess of the liver or spleen may burst into the stomach, and an ulcer of the colon has also been known to communicate with that viscus, the fæcal matter passing upwards. The *form* of the ulcer is very various, generally circular or oval, but sometimes linear, or irregular. The *number* is equally uncertain; generally one in chronic gastritis; but in acute gastritis there are often several, and in some cases the stomach is absolutely "*criblée.*" In size they vary from a pin's-head to a sixpence, or to half-a-crown; and in some cases of poisoning from mineral acids, a large portion of the mucous membrane sloughs off. The ulceration in some rare cases has ended in gangrene.

Hypertrophy of the stomach sometimes extends to all its coats, or it may be limited to some one or more of them.

When the mucous membrane is hypertrophied it sometimes appears granulated; at others large patches rise up from half a line to two lines above the general level of the mucous membrane. Instead of affecting all the web of the mucous membrane, the villosities are sometimes alone hypertrophied. The muscular coat also often participates in the disease, and so also may the serous membrane; and when all the coats are affected the thickness of the stomach is often double or treble its usual substance.

Atrophy.—The membranes of the stomach may be collectively or individually atrophied. Atrophy of the mucous membrane may be limited to the villosities, which sometimes entirely disappear. Again, the mucous membrane may be generally atrophied till it is reduced to a third of its usual substance. The muscular tissue may be reduced to a few scattered pale-coloured fibres; while, taking the stomach generally, it may be so atrophied as to be almost without villosities, almost without muscular fibre, and so reduced as to consist only of an attenuated serous and an equally attenuated mucous membrane.

Dilatation of the stomach may be general or partial. Andral gives a case in which the stomach had acquired such an increase of size that it covered the whole mass of intestines, so that its greater curvature touched the os pubis. In stricture of the pylorus the stomach is often so dilated as to reach the umbilicus, and even often exists to this extent when the pylorus is healthy. This augmentation of capacity usually takes place at the expense of the muscular coat, of which only a few fibres can be traced, the great mass of them being replaced by an excess of cellular tissue. Dr. Baillie gives an instance of partial dilatation of the stomach, or of a pouch being formed in which five half-pence had been lodged. The coats of the stomach, he says, were thinner at this part, but were not inflamed or ulcerated.

Contraction.—The stomach is sometimes found so contracted throughout the whole of its extent as not to be larger than a portion of the small intestine. This state of parts is most common in drunkards.

Ramollissement.—We sometimes open patients and

find that the slightest traction of the walls of the stomach ruptures them. In these cases the mucous membrane, the muscular coat, the peritoneum, and also the cellular tissue connecting these coats, are softened, and in some cases almost liquified, or transformed into a sort of transparent jelly, and has hence been termed, by Cruveilhier *ramollissement gélatiniforme*. This state may exist with the preservation of the normal colour of each tunic, or they may be paler or redder than usual. The ramollissement may be limited to one tunic, or extend to all. The splenic portion is the part most usually affected ; but Andral has observed it over the whole of the surface of the stomach. In one instance the walls of the entire stomach resembled a cherry-red pulp ; and the child died with continual vomiting. Another child had vomiting followed by convulsions and coma, and died in five or six days from the commencement of the illness. The stomach in this latter case was reduced to a fine web, and readily tore ; but unlike the former case, it was remarkably white, although the course of the disease had been most rapid. In other cases the ramollissement is partial.

Polypi sometimes grow from the mucous membrane of the stomach. Breschet gives the case of a woman, aged 69, in whose stomach there was found a considerable growth of this description. M. Rullier presented to the Académie Royale de Médecine a stomach from which there grew no less than eighty of these excrescences, whose medium size was that of a hazel-nut. Monro gives the case of a lady, aged 45 years, and the mother of several children, in whom was detected, during life, a tumor as big as an orange, on the left side of the navel. Medicine afforded her no relief, and she died emaciated. On examining the body, the tumor was found to be adhering, by its neck, to the villous coat of the stomach. The surface of the tumor was smooth, and the body of it so firm, solid, and tough, that it was cut through with some difficulty. The section of the polypus exhibited an uniform surface. In the museum of St. Thomas's Hospital there is a stomach containing six or eight of these fleshy growths, each about the size of a small nut.

Symptoms.—Acute gastritis, with ulceration, is often seen in cases of fever, and often without any local symptom to mark it. In one case it was accompanied by great anxiety, restlessness, and depression, with great difficulty in swallowing, almost equal to that in hysteria; but there was neither vomiting nor pain, and many authors are of opinion that pain is rarely felt unless an eschar is detached and the subjacent tissues exposed.

Acute idiopathic gastritis is so rare that hardly any writer has ventured to describe the symptoms. When it occurs, however, from poisons, as arsenic, corrosive sublimate, or oxalic acid, the symptoms, though they greatly vary, are generally admitted to be pain of the epigastrium, increased on pressure, with vomiting and purging. The face is pale or red, and the eyes are faded or brilliant and injected, the skin hot or cold, dry or covered with sweat, and the pulse full and strong, or weak and rapid, according to the dose of the poison, and the stage of the disease, and the constitution of the patient.

The course of acute gastritis is generally short, and the patient usually perishes between the first day and the end of a week, and more commonly on the second, third, or fourth day. In cases more prolonged the patient appears recovered after the third or fourth day, suffers no pain, and the vomiting subsides; but this apparent convalescence is often interrupted at the end of two or three weeks by the detaching of the eschar, sometimes followed by hæmorrhage, and which compromises the life of the patient. In other instances the ulcer penetrates deeper, and the patient dies of peritonitis.

In chronic gastritis, even when ulceration exists, the symptoms present an endless series of shades. In general the patient experiences a dull pain in the epigastric region, considerably increased on pressure, and which is worse after eating. This pain sometimes intermits, but more usually is continued. The appetite may be diminished or increased; but digestion is generally difficult and painful, and sometimes followed by vomiting. The mouth is dry, the tongue red or coated, and the bowels irregular. One case is given, in which the suffering of the patient was so trifling that he was dining out, and in the act of singing a jovial song, when the peritoneal coat rupturing, he was instantly seized with most acute pain, and in a few hours died from peritonitis. Dr. Farr gives a case of a hairdresser in whom the pain occurred only at long intervals, and in severe paroxysms. This man had suffered occasionally from attacks of severe abdominal pain for seven years, but which were always relieved by a glass of brandy. On the day of the fatal attack he had endured the pain almost without interruption, yet continued to attend to his business, and in the evening even went to market to buy fish for his supper. On his return his suffering was intolerable. He took his usual glass of brandy; but this was followed by vomiting. He was anxious to get to bed, but dreaded going up stairs; at length, however, making a desperate effort, he ran up, and fell as he entered the room. Peritonitis was established, and after death an ulcer, with ruptured peritoneal coat, was found in the stomach. In chronic ulcer of the stomach the peritoneal membrane sometimes forms adhesions to the walls of the abdomen, and the ulcer eating through them, an artificial anus, is formed, which has led to many very valuable observations being made *per visum* on the nature of digestion.

Hypertrophy and *atrophy* of the coats of the stomach are perhaps not to be determined during life, except as matters of inference, from the indigestion which usually accompanies them. *Dilatation* of the stomach may perhaps be ascertained by examination, and this is especially to be suspected in the "huge feeder;" its enlargement being perhaps caused like enlargement of the bladder by over distention. It is also found in the melancholic patient. *Contraction* of the stomach is more usually seen in the drunkard, and is the consequence of over excitement from excessive stimulus. Louis states, that in the greater number of his cases of ramollissement the patient has laboured under indigestion, and often for years; but that at the period at which he conceives the ramollissement to have commenced, the loss of appetite was complete, and accompanied by gastralgia, nausea or vomiting, thirst, and some fever. These symptoms he considers to occur with or without exacerbations and remissions, till the death of the patient, which takes place in about six weeks or two months from the time the disease is well marked. Louis is also of opinion that, judging from the symptoms, persons affected with ramollissement do sometimes recover. It will be evident, however, that the symptoms which have been mentioned are common to many other disorders

of the stomach, and can hardly be considered as sufficiently diagnostic.

We possess no means of determining the existence of polypi of the stomach, unless the tumor be so large that it can be felt through the abdominal parietes.

Diagnosis.—Gastritis, when accompanied with pain and vomiting, can hardly be confounded with any other disease. When those symptoms are absent, it may be inferred, from the character of the epidemic, but cannot be proved to exist. In general, however, in gastritis the whole alimentary canal is disordered, and the diagnosis between the parts primarily and secondarily affected is extremely difficult.

Prognosis.—A few patients recover from acute gastritis; still the numbers are but few. A few also do recover from chronic gastritis with ulceration. The celebrated Breschet, editor of Bichât's works, was satisfied he had an ulcer of the stomach, and recovered by observing a most rigid diet. He ultimately died of a different disease, and on examining his stomach a cicatrix was found marking the seat of the ulcer.

Treatment.—The mucous membrane of the stomach, like the mucous membranes generally, is little influenced by bleeding, however copious. Still in acute gastritis some blood should be taken, and twenty or such other number of leeches that may be thought necessary should be applied to the epigastrium, and the bleeding afterwards be encouraged by a large linseed poultice, applied to the same part. The rest of the treatment consists in the exhibition of effervescing draughts, calomel, or neutral purging salts, combined with opium or other narcotic, so as to relieve the distressing sickness, and produce some action on the bowels. In the chronic forms of gastritis bleeding is perhaps unnecessary; but the same medicinal treatment should be pursued, though with greater moderation; and as the patient recovers, some bitter or mineral tonic may be substituted for the opiate. The other forms of organic lesion are only to be cured by an entire abandonment of the causes which have produced them; and even then it must be doubtful whether the organ ever recovers its healthy state.

Both in acute and chronic gastritis, the party should be limited to light puddings or slops till the severity of the symptoms has passed, when fish, and then poultry, and afterwards animal food, may be progressively allowed.

Of Enteritis.

Enteritis—is an inflammation of the mucous membrane of the small intestines.

Remote Causes.—The remote causes of enteritis are in many respects the same as those of gastritis, or the greater number of morbid or other poisons. The intestines, however, are much more frequently acted upon by those and every other cause than the stomach. The effects of wet and cold in disordering them are familiar to everybody. They are also more commonly deranged by errors in diet, as by acid fruits or pickles, which often agree with the stomach, but greatly disorder the intestines, and thus lay the foundation of inflammation. Enteritis is likewise produced by many mechanical accidents, as the many forms of hernia, from which the stomach is nearly free.

Predisposing Causes.—Age has much influence in the production of enteritis. The high susceptibility of the bowels in childhood greatly predisposes that period of life to enteritis. In adult age the greater exposure to morbid poisons, and to mechanical accidents, renders this form of disease likewise common to manhood. Old age, though far from being exempt, is not so liable to this affection.

Pathology.—Inflammation of the mucous membrane of the small intestines may take place either in the web of the membrane, or in the follicles, or both. The inflammations of the mucous membrane, taken generally, are the diffuse, the serous, the adhesive, the ulcerative, and the gangrenous, and perhaps all these different inflammations may exist in different parts of the same intestine at the same time. Suppurative inflammation, however, without breach of surface, is unknown in this part of the alimentary canal. The inflammations which have been mentioned may be acute or chronic.

Acute diffuse inflammation of the web of the mucous membrane of the intestinal canal is marked by the same pathological phenomena that we meet with in the stomach, or by redness, thickening, and impaired cohesion. The redness is the same as in gastritis, or a *deep venous red*, approaching to blackness; and this may be either partial or general, dotted or arborescent, striated or in patches. The thickening is generally sensible, and often considerable. The impaired cohesion is not so constant as in the stomach, and in no case can the mucous membrane be removed in such large portions. In the chronic forms of diffuse inflammation, the colour, thickening, and the cohesion, are not greatly dissimilar; but in general the thickness is more considerable, the cohesion of parts, instead of being impaired, is often rendered more tenacious, while the dark venous hue, on subsiding, leaves a greyish or slate-coloured tint, from a deposit of melanic matter in the substance of the membrane.

Serous inflammation of the mucous membrane of the small intestines may be inferred to exist from the large quantities of serous fluid often discharged by stool, during life, at the same time that the abdomen is the seat of pain and tenderness. After death the fact may be proved by the loose diffluent fæcal matter often found in the small intestine; at the same time the mucous membrane is partially or generally inflamed.

Adhesive inflammation of the mucous membrane of the small intestines is an extremely rare occurrence. "I have," says Dr. Baillie, "seen in violent inflammation scattered portions of coagulable lymph thrown out upon the surface of the villous membrane. This, however, is very uncommon" (p. 158). Billard has seen it but twice in the intestines of children. Andral has never seen it. A black man, a gentleman's servant, admitted some years ago into St. Bartholomew's Hospital, presented a striking instance of this disease. The man had been for some short time ill, when he was seized with dropsy, and for this disorder he was sent to the hospital. He died in two or three days, and, on opening him, the lower portion of the ilium for the space of eight or nine inches was covered with a false membrane, forming a perfect cylinder about two lines in thickness, but which did not present the slightest trace of organization.

Ulceration of the mucous membrane of the small intestines is much more common than adhesive inflammation, and is indeed by no means infrequent, especially from the action of the typhoid and the paludal poisons; and this ulceration may take place either at its free or at its adherent surface. When it takes place at the free surface the ulcer, says Andral, may form in the centre of a point of inflammation, the mucous mem-

brane around being healthy, or it may form in the midst of an extended patch of diffuse inflammation without the follicular structure being in any degree affected. Again, the sub-mucous cellular tissue may inflame and become the seat of a number of small abscesses, which may point like so many pock. The apices of these abscesses become thinned and softened, till at length the mucous membrane ruptures, and the pus they contain is poured into the cavity of the intestine. The form, edge, and base of these ulcers are not unlike those found in the stomach, except that the ulcer with a sharp perpendicular edge, as if made by a punch, is much more rarely seen.

Besides *inflammation* and ulceration of the *web* of the membrane, the follicular structure may be either separately or conjointly with the former the seat of inflammation and of ulceration.

The follicular glands of the small intestines are liable to the serous, the adhesive, and the ulcerative inflammations. In serous inflammation the gland is enlarged, transparent, and looks like a drop of pellucid water, having a small black point in the centre, which is the mouth of the duct. When adhesively inflamed, the gland is smaller than in the former instance, opaque, and also much harder, so that they appear like a number of little white granules. The glandular structure also very readily runs into ulcerative inflammation, and when the *plaque de Peyer* is its seat the ulcer generally takes the oval form of the patch. These ulcers have various edges and bases, and sometimes burrow so deep as to rupture the intestine. As this form of disease, however, most principally occurs in typhus, dysentery, and as a consequence of phthisis, the reader is referred to those articles for the more general laws which attend this form of disease.

Inflammation of the intestines, says Dr. Baillie, sometimes, although rarely, advances to mortification. When this is the case the mortified part is of a dark livid colour, has lost its tenacity, and is very readily torn, or as easily as a rotten pear.

Ulceration and mortification sometimes lead to the perforation or rupture of the intestine, when, the contents of the bowel escaping into the cavity of the abdomen, the patient dies of peritonitis. The intestine, however, when ruptured, does not always give rise to peritonitis, for the ulcerated portion may adhere to some neighbouring viscus, as the kidney, liver, or colon; or it may adhere to the walls of the abdomen, and give rise to an artificial anus, so that the fæcal matter is discharged externally through an aperture of the abdomen. In a very few cases the ulceration, and especially when invagination has taken place, is so extensive that a portion of the intestine has been known to be detached and passed by stool. Hevin relates a case in which 28 inches of the small intestine were discharged by stool; and Andral another, in which 30 inches, together with a portion of the mesentery, was passed in the same manner, and yet this patient lived three months afterwards. The explanation of the patient being able to survive this extraordinary pathological result is twofold,—or, that the ends of the intestine, after the diseased portion has sloughed away, are so completely in contact as to unite by the process of adhesion; or else, as Mr. Travers has shown in his experiments on animals, that a layer of lymph is deposited around the peritoneal surface of the diseased portion of the gut, as around a broken bone, and this becoming organized about the time the separated portion is detached, the continuity of the canal remains uninterrupted.

The small intestine, like the stomach, may be *hypertrophied* on one or more of its coats, so that in some instances it has been found of double its natural weight and thickness. It has also been found exceedingly *atrophied*, even when in a state of chronic inflammation and ulceration, so that the membrane has become of extreme tenuity and almost semi-transparent.

Portions of the small intestine have also been found so enormously *dilated*, that Andral has seen the duodenum as large as the pyloric portion of the stomach; while, on the other hand, it is sometimes as remarkahly *contracted*. Forten mentions a case of poisoning by nitric acid in which the whole mass of intestines might have been held in the palm of the hand. This contraction, however, may be partial, and be limited perhaps to a single muscular fibre, which has contracted under some high irritation, and become bound down by adhesive inflammation; and in this manner a *stricture* is formed. A young lady died of phthisis and of mesenteric disease, and, on examining her, a stricture was found in the upper portion of the ilium formed in this manner, which so contracted the diameter of the intestine at that part that it hardly exceeded that of a garden pea. A small plum-stone, which it was supposed she must have swallowed a twelvemonth before, was stopped at this point, being too large to pass through the stricture.

The small intestine, like the stomach, is liable to undergo the process of *ramollissement*, and is occasionally ruptured from this cause. A case of ramollissement of the duodenum was met with not long ago, when that intestine tore like a piece of wetted paper. In one instance a *fatty* tumor was found hanging pendulous by a thin pedicle in the small intestine. *Polypi* have also occasionally been found.

Symptoms.—Dr. Baillie says that inflammation of the mucous membrane, or enteritis, among other symptoms, is characterized by acute pain; and Dr. Good says that this pain sometimes "arises to agony." This, however, is erroneous; for the patient, as in fever, is often destroyed by enteritis without having complained of pain. Pain, however, sometimes does exist, or at least is made manifest by pressure; and in this case its more common seat is the ilio-cæcal valve, and the epigastrium, either because those parts are actually the seat of the disease, or else because those parts, like the extremities of a duct, are sympathetically affected. Another symptom in the great majority of cases is diarrhœa, often accompanied by meteorism, and in a very few instances by constipation. The functions of the stomach are in all cases impaired, and occasionally there is vomiting. These symptoms are generally combined with some fever, and a full but not very frequent pulse. The tongue also, if the disease be mild, is white and moist; but if severe, it is brown and dry, and the patient falls into a typhoid state. When the enteritis is the result of the action of a morbid poison, the fever precedes the other symptoms; when it results from any other cause, the febrile affection always succeeds. If the intestine be ruptured into the cavity of the abdomen, and peritonitis follows, the patient is seized with a sudden coldness, a most excruciating pain of the abdomen, and with a most rapid pulse, and in a few hours he lies in a state of irrecoverable collapse; and, except a short respite from pain after pus has been effused, he dies, and apparently from insufferable agony.

The symptoms of chronic enteritis are nearly similar but more moderate,—that is, pain may or may not be present, and in no instance is it of great intensity; the bowels are generally relaxed and the stools sometimes mixed with blood; the patient has little appetite, or nauseates his food; the pulse is little accelerated; and the tongue white and coated, with often a bitter taste in the mouth.

Hypertrophy of the small intestines is not uncommon, especially in dropsy, when they sometimes acquire a double or triple thickness, and apparently an equal excess of weight. The intestines are also as constantly atrophied in phthisis, and their tissues rendered almost transparent; but no particular symptom has been remarked by which these different states can be determined during life; neither can dilatation of the intestine, except when it becomes the seat of meteorism. Stricture of the intestine is more strongly marked, as by frequent attacks of colic or constipation, or of diarrhœa; but even these symptoms, it will be seen, are not strictly diagnostic, as they are common to many other disorders of the intestines. The symptoms of *Ramollissement* of the intestine are extremely obscure, and are only determined to be derangement of the alimentary canal generally, as diarrhœa, indigestion, vomiting, and pains, often severe, but occurring in paroxysms,—symptoms which are common to many other diseases both of the intestines and stomach.

Diagnosis.—The absence of pain, so common in enteritis, renders it at all times difficult to distinguish that disorder from mere deranged function of the intestinal canal. Even in fever the existence of enteritis is often a matter of mere inference, deduced from the nature of the prevailing epidemic.

Prognosis.—Enteritis, when occasioned by fever, or by some mechanical cause, as hernia, is not always a grave disorder. Many, however, fall when it is caused by hernia. In fever, whether the follicular structure be or be not affected, one in six or seven are supposed to recover.

Treatment.—The treatment of enteritis, when not arising from a morbid poison, is by leeches to the abdomen, gentle purgative medicines combined with an opiate, fomentations, and purgative or opiated enemata. After the inflammation has subsided, mild tonics, as salicine, or the tinct. aurantii ex inf. aurantii comp., should be substituted, to recover the lost tone of the parts.

The diet of the patient should be strictly anti-phlogistical, or slops and light puddings.

Colitis

Is an inflammation of the mucous membrane of the colon.

Remote Cause.—The colon, or large intestine, is acted upon by many morbid poisons, especially by the paludal poison. It is extremely sensible also to cold and wet; is readily deranged by every error in diet; and suffers indeed from all the causes producing inflammation in the superior portions of the alimentary canal.

Predisposing Causes.—Colitis is common to all ages. Children suffer from it during teething; the adult, after exposure to the paludal and typhoid poisons; and old age, perhaps, from the general predisposition there now exists to disease.

Pathology.—The inflammations of the mucous membrane of the colon are similar to those of the small intestines, with the addition, that it readily runs into the adhesive and into the suppurative inflammations. It so readily takes on adhesive inflammation, that large quantities of loose unorganized lymph are often passed, filling sometimes a large chamber-vessel. It also readily runs into suppurative inflammation, large quantities of pure pus being passed, sometimes many ounces, and indeed much more than can be accounted for by the ulcerated state of the intestine, and, consequently, it is highly probable this secretion often takes place without breach of surface. This intestine is also occasionally the seat of simple stricture, or it may be more generally contracted; more commonly, however, it is greatly dilated. It is also occasionally hypertrophied or atrophied, and is occasionally the seat of polypi.

Symptoms.—The *general* symptoms of colitis are not greatly dissimilar to those of enteritis; but the *local* symptoms are more marked, the stools being more frequent, often containing large quantities of mucus, lymph, blood, or pus. The colon, however, being an organ of waste rather than of nutrition, the course of this disease is often much longer than that of enteritis, and the patient preserves a much greater degree of *embonpoint*, and is less frequently affected with fever than in the latter disorder. The derangements of the stomach are also much less marked, so that he preserves some appetite. In other respects, however, the symptoms are nearly the same.

Diagnosis.—In colitis the stools are more frequent, contain more blood than in enteritis, while lymph or pus have hardly any other source than inflammation of the colon.

Prognosis.—The prognosis in all cases in which pus is not present is favourable.

Treatment—does not differ from that recommended in enteritis.

Of Inflammation of the Liver.—Hepatitis.

Hepatitis is an inflammation of the substance of the liver, and is a disease which has been known from the earliest periods of medicine. The numbers said to have fallen from this affection in England and Wales, in 1839, were 428.

Remote Cause.—The remote causes of hepatitis are very various. The paludal poison is evidently its most frequent cause, and it is probably owing to this circumstance that hepatitis is so common in the East Indies; for in Bengal it forms six per cent., and in Madras 17 per cent.; or, taking the whole mortality of our armies in the East Indies, from this cause, it varies from six to 22 per cent. In this country, where hepatitis arises principally from general causes, and from errors in the quantity or quality of our diet, and more particularly from indulgence in spirits, only one person in about 145 is returned as dying of liver diseases. If, however, we include jaundice, which probably for the most part depends on chronic disease of the liver, and also the many cases of dropsy which often arise from diseased liver, the proportion will be infinitely increased, or perhaps not less than 1 in 8 or 10. The effects of general causes in the production of liver disease is remarkable in animals. Poultry, it is well known, are often "put up" with the intention of producing enlarged livers, and the means used are very various. A room of high temperature is essential, when some entirely deprive them of all food and drink; others of all drink, but cram them; while others feed them on charcoal. These methods not only cause fever and emaciation of the body generally, but also enlargement of the liver: which latter forms

the dish, we can hardly call it the delicacy, known as the *pâtés aux grosses foies*. These conditions are nearly those in which the drunkard places himself; the spirits, a highly carbonized fluid, produces heat and fever, loss of appetite, and a thirst so great that ultimately nothing but spirits can quench it. The difference between temperance and intemperance in the production of hepatitis may be seen in the circumstance that 227 per 1000 of the European troops die from this affection in the East Indies, while the proportion among the native troops is only 70 per 1000.

Predisposing Causes.—All ages are liable to hepatitis. Children, if properly dieted, would, in all probability, be nearly exempted; but many of those of the lower orders are early initiated in the use of " a drop," causing a most fatal and unsightly enlargement of the liver. The middle periods of life, however, from a greater indulgence in this pernicious habit, appear most liable to this affection.

Pathology.—In treating of the inflammations of the liver, it is convenient to consider the inflammations first of the ducts and then of the substance of this organ.

The mucous membrane of the gall-bladder and ducts is liable to the diffuse, the adhesive, the suppurative, and the ulcerative inflammations. Thus, if a dog be purged with jalap, the mucous membrane of the gall-bladder is found red and injected; while, if the inflammation, from any cause, be more intense, it is not only red and injected, but also thickened so that a probe can hardly be passed through the swollen lips of the ductus communis or ductus cysticus. As instances of adhesive inflammation, Louis gives eight cases in which the ductus cysticus or ductus communis were obliterated and reduced to a mere fibrous cord; and every museum contains specimens of this kind.

Stahl gives a case in which the gall-bladder contained an ounce of pus unmixed with bile, and Andral has likewise seen pus in the gall-bladder. During the Walcheren expedition the gall-bladder was repeatedly found ulcerated, and Louis has given several other instances. The ulceration sometimes proceeds till the gall-bladder ruptures, and if the bile escapes into the peritoneal cavity the patient dies of peritonitis. Dr. Abercrombie has given a case of a man aged 50, in which the gall-bladder adhered to the walls of the abdomen and ulcerated externally, so that the bile continued to be discharged by this biliary fistula for three years, and sometimes so profusely that in a visit of 15 to 20 minutes, four ounces of bile have been collected. An instance is also given of rupture of the cystic duct at its entrance into the gall-bladder.

The gall-bladder and ducts, besides being inflamed, have often been found hypertrophied, and, in a few instances, atrophied; but they have been more commonly found dilated or contracted. When a calculus has just passed into the duodenum, the ductus communis has been found so enlarged as to admit the middle finger. Again, if that canal has been obstructed by a calculi or other cause, the gall-bladder has been found so enormously distended that, instead of an ounce of bile, its natural contents, it has contained no less than 12 pints.

The gall-bladder and ducts, besides being dilated, have not unfrequently been found greatly contracted. Mr. Twining says that in India the gall-bladder is commonly distended with bile in persons recently arrived in that country, and, as a consequence, inflammation takes place, which, on subsiding, is followed by a considerable contraction or diminution of its capacity. Andral gives a case of adhesion and ulceration outwards of the gall-bladder, and by which means biliary calculi were discharged externally through the walls of the abdomen; but on the party dying, not a trace of the gall-bladder could be found, and in its stead a mass of cellular tissue of considerable density, and in which the ductus cysticus terminated as in a *cul de sac.*

Besides the preceding forms of disease, the gall-bladder has been found *indurated*, and in some very rare instances cartilaginous and bony. Another disease incident to this cavity is hydatids. Simmons gives the case of a woman who had a tumor on the left side of the abdomen, and on examining her it was found to be caused by an immense gall-bladder, which contained 16 measured pints of hydatids. Walter also once met with hydatids in the gall-bladder.

Inflammation of the substance of the liver is not uncommon, and is limited to the diffuse, to the suppurative, and to the ulcerative inflammations. The liver is also known to possess the property of adhesive inflammation by its healing after being wounded; but, as no free lymph has ever been found effused into its tissues, this property, if called into play under ordinary circumstances, must be limited to mere interstitial deposits, causing enlargement or induration of this viscus. These inflammations may be acute or chronic, and the phenomena vary so much according as they occur in healthy or diseased livers, that Gendrin has produced inflammation of the livers of animals artificially in order to determine more particularly its effects in the healthy organ.

Diffuse inflammation of the liver is marked by the liver being greatly gorged with blood, by its being of an unusually deep venous or liver colour, by an evident increase of its size and density, while the finger more readily perforates it than usual. If we now cut into it, the ducts present fewer yellow points than usual, and on opening them we find them inflamed and gorged with bile less viscid than in health. In this state the capsule of the vena portarum, and also the duodenum, are red and injected; the mesenteric veins distended with blood, and the spleen evidently enlarged. If the diffuse inflammation be of a still higher intensity, the affected portion becomes marbled, and bile is no longer contained in the ducts, but in its stead a dark, turbid, bloody serum, while the substance of the liver is so broken down that the slightest pressure reduces it to a mere pulp like a softened spleen, and injections now neither penetrate the ducts, the arteries, nor the veins of the inflamed part. But even in this state the inflammation may terminate by resolution and the patient recover.

The inflammation, however, may proceed, and pus be effused, at first in the centre of the darkest and most disorganized spots, forming a number of different points or foyers which enlarge, unite, and at length form one or more abscesses. The abscess formed, a new process now commences, which is the formation of a lining membrane; but this is rarely perfected in consequence of the abscess rupturing, or of the death of the patient.

Inflammation of the substance of the liver for the most part produces inflammation of the serous membrane which covers it, by which means adhesions take place between the liver and the surrounding parts, and in this direction the abscess usually bursts. Andral has seen this accident take place into the pericardium.

Not unfrequently it takes place into the stomach, duodenum, arch of the colon, or other part of the intestinal canal. It has been known to take place into the vena cava, the infundibulum of the kidney, and in one remarkable case adhesion took place to the diaphragm at a point where the lungs also were adherent, and the ulcer penetrated them, and the matter of the abscess of the liver was coughed up and spat out of the mouth. In other cases no adhesion takes place, and the abscess bursts into the cavity of the abdomen, and the patient dies of peritonitis. It is seldom that the abscess points in more than one direction; but there have been instances in which it has burst not only in one but in two and even three or more points.

The fluid contents of the abscess are in general well-digested pus. Sometimes it is sero-purulent, loaded with flakes of albumen or lymph, and sometimes merely an ill-conditioned sanies. The walls of the abscess are generally unequal, and have the appearance of an ulcer; and Mr. Marshall has in Ceylon seen them in a state of gangrene. It is seldom that more than one abscess exists, but occasionally two or more have been met with. The abscess greatly varies in size, sometimes being hardly bigger than a pea, while in other cases it has contained one, two, and even more pints of pus, so that the larger portion of the liver has been converted into a mere sac. Dr. Chisholm says he has witnessed three-fourths of the liver destroyed in this manner.

The form of abscess that has been described is of the acutest kind, and such as occurs in a perfectly healthy liver. But it sometimes happens that an abscess forms in a white or nutmeg liver, and in these cases scarcely a red vessel is to be seen in the whole substance of the liver, which is sometimes so soft that the blood-vessels have been dissected out by the finger. An abscess having burst, the patient often dies, but he also sometimes recovers. In the latter case the abscess granulates, and the part is repaired as in ordinary abscess; but, as in ordinary abscess, the granulations contract, so that a deep hollow with a central cicatrix marks the seat of this formidable affection.

Besides these acute forms, the liver is liable to many chronic forms of inflammation. It may, for example, be simply *hypertrophied*, acquiring a great size, thrusting up the diaphragm, and extending not only into the pelvis, but also far over to the left side. The increase of weight under these circumstances is often so considerable that the liver has been known to weigh between 30 and 40 lbs. Again, it may be simply atrophied and reduced to one-third of its usual size, or to a mere shapeless lump, and, in these cases, the fleshy fibre is often so changed as to resemble in some degree a muscular structure.

When the liver is hypertrophied or atrophied, it is often also indurated, or else softened. The hard indurated liver is well known, while, in some instances, it is so softened as to be almost a bag of blood.

The other varieties of chronic inflammation of the liver are very numerous; but there is one of them usually termed the "nutmeg," or granular liver, which requires some notice. To explain this form of disease, Andral supposes the liver to be composed of a fleshy substance, and of a cellular tissue, an hypertrophied state of the latter giving rise to the remarkable disease in question. Bouillaud has considered the liver to be composed of a yellow and of a red tissue, while Mr. Kiernan supposes that the difference of colour is the result of mere congestion, and conceives that the nutmeg liver is caused by thickening of the capsule of Glisson, which he has shown accompanies the portal vein, the hepatic arteries, and the biliary ducts, and forms a sheath around them. These hypotheses have been considered by Laënnec and others so unsatisfactory, that many pathologists have considered the peculiar appearance of the "nutmeg liver" to be owing to the deposition of a peculiar heterologue substance, which they have termed scirrhosis. It is evident much further observation is necessary to elucidate this subject; but one remarkable law in this affection is, that the liver is for the most part hypertrophied, and more especially the left lobe.

The substance of the liver is very often loaded or infiltrated with fatty matter, a degeneration termed steatoma, and which is common in phthisis. In this case it usually, but not necessarily, becomes larger than in health, often preserving the impression of the ribs, or of the finger. It is sometimes harder and sometimes softer than in health, is of a cream or pale yellow colour, sometimes resembling a dead leaf, with brownish or deep orange-coloured spots. The presence of fatty matter is determined by an unctuous feel of the liver, by its greasing the knife, and rendering paper smeared with it not only transparent, but also readily combustible, as if dipped in oil. It may also be obtained by boiling. Dr. Bostock compares it to tallow, and Mr. Bird to a soft brownish fat, very fusible, of an unpleasant odour. Vauquelin obtained from a liver of this description 45 parts of a yellow concrescible oil, 19 parts of parenchyma, and 36 parts of serosity. In some few instances, says Andral, the fat, instead of being infiltrated into the substance of the liver, is deposited in masses. This state of the liver, Mr. Bowman conceives, is caused by an unwonted number of granules of fat, of which in health each lobule contains only a few.

The liver is also often the seat of hydatids. These are for the most part contained in cysts, whose dimensions vary from the size of a nut to a large orange, occasionally occupying nearly the whole substance of the liver. The walls of these cysts are usually fibrous, and not to be separated from the liver without tearing that organ. It sometimes happens that the cyst is extremely superficial, and projects beyond the surface of the liver, so that should the disease be chronic, and the patient emaciated, the nature of the complaint can be determined during life. The hydatid cysts may at length rupture, and these animals escape either externally through the abdominal walls, or into the cavity of the peritoneum, or, should adhesions form, may even be thrown up by the mouth. In general, however, the patient falls before this latter addition to his miseries takes place.

Symptoms.—The symptoms of acute hepatitis, it might be supposed, were principally pain and tumefaction of the liver; but the liver is an organ of dull sensibilities, and its most acute and destructive inflammations often take place without any pain being present, certainly not severe pain, unless the peritoneal coat is affected. Thus, according to Mr. Twining, out of 28 cases admitted into the Calcutta Hospital, and which ultimately proved to be liver diseases, only 16 were determined at the time, five being considered to be dysentery, two continued, one intermittent fever, two abdominal inflammation, one chronic diarrhœa, and one debility.

The most prominent symptoms of hepatitis are, however, some tumefaction of the liver, some pain or uneasiness of the liver, or else of the adjoining parts, as the thorax, abdomen, or right shoulder; 2ndly, an affec-

tion of the bowels, as diarrhœa or dysentery; and lastly, pyrexia in a continued remittent or intermittent form.

When pain is present, it is found to be in most instances aggravated by lying on the right side, apparently from the greater weight now pressing on the liver, while, in a smaller number of instances, the pain is felt most acutely on turning on the left side, probably from adhesions having formed to the ribs. In general, however, the easiest position is on the back, or else a little over to the left side, and towards the termination of the disease the patient is sometimes observed lying in a position which he had previously declared himself unable to assume.

In a few instances acute hepatitis exists without any pyrexia. Some fever, however, is commonly present, and in general it often commences with shivering, vomiting, and purging—symptoms which gradually diminish in a day or two, leaving the patient comparatively free from fever, and the pulse nearly natural. These paroxysms, however, recur, and at intervals of various duration, sometimes returning as regularly as those of intermittent or of remittent fever, while, in other cases, the periods are less marked, the chief symptoms being rigors occuring at irregular intervals, frequent pulse and sweats, the latter chiefly occuring in the night, and so copious as in some instances to pour off the body of the patient.

The state of the tongue on the admission of the patient is usually furred and loaded, but in the course of a long disease it as usually cleans, or is only slightly foul, till the death of the patient. In some few instances, however, it becomes brown and dry.

The animal functions, as in phthisis, are often marked by the "cheerful hope" which illumines every hour the patient has to live, but in others the depression amounts to despondency, with restlessness and want of sleep. At last, however, delirium obliterates the past, and throws a veil over the future, and with this symptom the patient dies, either with or without jaundice.

In the midst of the symptoms that have been mentioned, perhaps the abscess points; and now the patient becomes hectic, his pulse rapid, and he is covered with a copious and clammy sweat. The life of the patient now in a great measure depends on the part where the abscess points; if it bursts for instance into the peritoneal cavity, the patient assuredly dies of peritonitis; while, if it bursts into the stomach or intestinal canal, or else externally, he often recovers. It is often necessary, when the abscess points externally, from the urgency of the symptoms, to open it; but Mr. Marshall found in Ceylon that in the majority of cases he examined the operation would have been fatal, no sufficient adhesions having taken place to fix the liver to the abdominal walls, and thus prevent the escape of pus into the peritoneal cavity. The abscess having been opened, the patient either sinks, or else re-action takes place; and when the fever thus excited abates, a laudable pus is secreted, the appetite improves, the abscess granulates and cicatrizes, the external wound heals, and the patient recovers.

The different forms of chronic hepatitis are hardly to be distinguished from each other, and are generally denoted by indigestion, irregularity of the bowels, jaundice, and dropsy. An indurated or hypertrophied liver can generally be detected through the integuments, and an examination of the right hypochondrium should never be neglected. Large hydatid cysts can also sometimes be determined during life either from the sensible fluctuation of the tumor, or from the irregularity of its surface.

Diagnosis.—Abscess of the liver is to be distinguished from enlarged gall-bladder or gall-ducts, and from encysted dropsy of the liver; diffuse inflammation of the liver from peritonitis. Chronic hepatitis is to be distinguished from leucorrhœal pains, from cancer, or other organic disease of the stomach.

Prognosis.—Acute hepatitis, occurring in a healthy liver, generally terminates favourably in this country. If, however, it occurs in an unhealthy liver, or as a sequel of dysentery, it is almost uniformly fatal. In the East Indies the mortality among the European troops is $34\frac{1}{10}$ of those attacked, while of the natives seized only one-tenth fall.

Treatment.—The treatment of hepatitis as it occurs in the East Indies, a disease from which two persons out of three alone recover. cannot be said to be efficient or even well understood, and consequently much difference of opinion must necessarily prevail on this subject, and much opposite experience. The two great experiments which have hitherto been made are bleeding and mercury; and it may be affirmed as a general result, that those means combined are more beneficial and are oftener followed by the recovery of the patient than either of them employed separately. In the young and sthenic European, then, in the East Indies, it is in general necessary to take 15 to 20 ounces of blood, and then to introduce mercury so as to affect the mouth, and as soon as that is accomplished the symptoms rapidly subside. One practical rule, however, is established with respect to the use of mercury in the treatment of hepatitis, which is, that after suppuration *has* taken place, mercury is not only inefficient but injurious. In Europeans, however, whose constitutions have been debilitated from a long residence in the East, bleeding is scarcely applicable, and mercury, from the more or less diseased state of the liver, ceases to produce its original good effects; still, however, it is the best remedy, but should be used with more caution, and many practitioners now limit themselves to pil. hydrarg. gr. v. two or three times a day, giving a draught containing some purgative salt every morning.

If suppuration should take place, the preceding treatment should be at once abandoned, and, if practicable, the abscess should be opened, for there is no chance of the pus being absorbed. As long a time, however, should be allowed to elapse as the patient's state will admit of in order that adhesion may take place. Still, on the slightest indication of the patient's sinking, a trocar should be introduced, for at such a crisis everything must be hazarded. The abscess having burst, either externally or internally, the patient must now be supported with a moderate quantity of wine, by a nutritious diet, and by mild tonics, as the tinct. aurantii, or the sp. ætheris nitrici. The time which elapses after opening an abscess till the patient's recovery is from one to two months.

In Europe, when the hepatitis depends on the action of a paludal poison, mercury so as to affect the mouth, as hydrargyri chloridi gr. v. ter die or bis die, is the most efficient remedy, and under it the patient for the most part recovers. When the hepatitis depends on any other cause, and occurs in a liver otherwise healthy, moderate bleeding is necessary; and the further treatment is a mild opiate, as the tinct. hyoscyami ♏ xv., with some mild neutral salt, as the sulphate of

magnesia, or sulphate of soda, ℥ j. 6tis horis. It is remarkable that many cases of hepatitis occur in the foul wards of the London hospitals, while the patients are liberally using mercury; and Baron Larrey states, that in Egypt he has seen hepatitis occur in patients labouring under the influence of mercury. If acute hepatitis should occur in a liver previously diseased, perhaps some mercury is admissible, but such an accident in London is extremely rare, and the practice not determined.

In the treatment of simple hypertrophy of the liver, the most beneficial remedies are the neutral salts, combined with some opiate, preparation of iron, or mild tonic, as the case may require, mercury in these instances being generally injurious rather than beneficial. For the treatment of the nutmeg liver no efficient remedy has been discovered; but in this, as in some of the other forms of chronic hepatitis, mercury, in small doses, but persevered in so as to affect the mouth, often gives the patient great temporary relief, and removes the jaundice or dropsy with which it is accompanied. A combination, however, of mercury and some neutral salt is, in most cases, to be preferred. The old Indian is often benefited by a course of Cheltenham or Leamington waters, without mercury, showing the power which the neutral salts possess over this class of disease. No remedy is known for the fatty liver, nor do we appear to have the power of influencing the formation or stopping the course of hydatids.

Splenitis

Is an inflammation of the substance of the spleen, a disease which is extremely rare in this country, only 27 cases being reported to have died in all England and Wales in 1838, and 29 cases only in 1839.

Remote Cause.—This disease is usually limited to certain districts in this country, as Cambridgeshire, Essex, or other paludal counties. It is common in the East Indies, especially in the low marshy districts of Bengal. It also occurs in the paludal districts of other parts of the world. Now and then it is said to originate from a blow or other accidental violence.

Predisposing Causes.—Splenitis is sometimes seen in children under 10 years of age, and is occasionally met with perhaps up to the age of 50.

Pathology.—The spleen is liable to the diffuse, to the suppurative, and to the ulcerative inflammations. It also possesses the property of adhesive inflammation, for wounds made into its substance have occasionally healed.

The few cases of disease of the spleen occurring in this country will account for its pathology having been little studied. In diffuse inflammation, however, of this viscus, we find it enlarged, of a deep venous colour, and its tissue so softened as to be readily broken down, or even reduced to little more than the consistency of coagulated blood. Diffuse inflammation may terminate by resolution, or it may proceed and pus be effused, and in this case one or more abscesses often containing several ounces of pus have been formed. The abscesses sometimes make their way to the surface, and thus demonstrate the ulcerative inflammation of this organ. Dr. Baillie mentions that the spleen has been found in a state of gangrene.

The spleen is sometimes hypertrophied. In the *Medical Commentaries* an hypertrophied spleen is mentioned which weighed 11 lbs. Portal speaks of another that weighed 30 lbs.; and Lieutaud met with one in a woman who had been ill 17 years, that weighed 32 lbs. It is singular that these large tumefied spleens sometimes subside very rapidly. Abercrombie mentions one that went down a week after the ague on which it depended had been arrested. The hypertrophied spleen is generally more or less indurated.

The spleen is occasionally atrophied so that little more than a rudimentary spleen remains. It is also found indurated and often greatly softened, so that it is imagined this viscus must be liable to the process of *ramollissement*, as well as of inflammation. Hydatids have been found in the spleen. In a few instances, small portions of the spleen, about the size of a nut, are found indurated and nearly white. These appearances are supposed to arise from slight effusions of blood into the substance of the spleen, which become organized, and the colouring particles being absorbed leave the appearances in question.

Symptoms.—Acute inflammation of the spleen is seldom seen unless accompanied by ague; and the additional symptoms are probably tumefaction and some pain of the left side, followed perhaps by dropsy.

In chronic affections even abscesses will sometimes form without any marked local symptoms. Dr. Abercrombie gives the case of a gentleman who was dyspeptic, but took a great deal of nourishment, who was much reduced in strength and flesh, but whose pulse was seldom more than 96 to 100; whose nights were good, though he was occasionally slightly feverish, and who was able till within a few days of his death to drive out in his carriage. This party at length died after suffering for two or three days from diarrhœa, but without any suspicion of the spleen being affected. On examination, however, the spleen was found something enlarged, and in its centre an abscess containing several ounces of pus.

The more common form of diseased spleen is hypertrophy; and in these cases it can almost always be detected by the touch, sometimes extending low down into the pelvic region, well over on the right side of the linea alba, and extending backwards almost to the spine. In these cases the patient complains of weight and uneasiness rather than of soreness; his pulse is natural, but his countenance is extremely sallow, his person greatly emaciated, his bowels irritable, and these symptoms are, for the most part, accompanied by œdema of the lower extremities, or by ascites. The most remarkable part of the history of these cases, however, is, that notwithstanding the sallow and emaciated state of the patient, he is often seized towards the close of the disease with hæmorrhage from the stomach and bowels, often so profuse that many pints have been passed or thrown up, greatly exhausting the patient, and rapidly hastening his dissolution. The cause of this cannot perhaps be well understood, but Mr. Hewson mentions as a curious fact, long known, that blood from the splenic vein does not coagulate, when exposed to the air, like the blood drawn from other veins. The large portion of the blood therefore circulating in these enlarged spleens, being thus rendered incoagulable, may perhaps afford some explanation of this unlooked-for phenomenon.

The course of chronic splenitis is generally long; the patient usually surviving one or more years in the worst cases.

Diagnosis.—Enlarged spleen can only be confounded with encephaloid or other tumor of the abdomen.

Elementary Principles of Medicine.

Prognosis.—Patients affected with enlarged spleen, and immediately removed from the paludal district, probably recover in a large proportion. If, however, the disease becomes inveterate, the patient dropsical, and the peritoneum thickened, he may recover, but is seldom completely restored, and is liable to all the accidents incident to frequent relapses.

Treatment.—Bleeding in splenitis has not been found greatly to influence the disease, or to effect a cure, while mercury, so beneficial in similar states of the liver, has been found for the most part not only not to be useful but even to be most pernicious. "I feel," says Mr. Twining, "more anxious fairly to show the baneful effects of mercury in the disease now under consideration, because the instructions usually laid down in the best systems of medicine do not inculcate the avoidance of mercury in any case of enlarged spleen, nor do they advert to the pernicious effects of that state of disease which I have termed vascular engorgement." This gentleman, in further proof his position, gives 13 cases in which the patient either died of mortification of the cheek, the nose, the upper lip, or after having lost all his teeth, or a large portion of the jaw, in consequence of the use of mercury, or supposing him to have survived the employment of this medicine, the spleen remained permanently enlarged. Dr. Voigt also, physician to the Danish establishment at Serampore, says that, although most authors recommend mercury, it is an indisputable fact that a very small quantity, even a few grains, generally occasion a profuse salivation, and so violent an affection of the mouth that mortification sets in, the teeth drop out, the bones become carious, and death ensues. In India, consequently, mercury and bleeding are little used, and in their stead a *spleen mixture*, not very dissimilar to that recommended by Celsus, is most in vogue; and the best, according to Mr. Twining, consists of pulv. jalap, pulv. rhei, pulv. Calumba, pulv. zingib, potass. supertart. āā. ʒ j., ferri sulphat. ℈ fs., tinct. sennæ, ʒ fs., aqua menthæ pip., ℥ ix. fs., of which an ounce or an ounce and a half is to be taken twice a day, or such quantity as may produce three or four stools in the 24 hours.

The spleen mixture is, in some instances, greatly efficacious, but in a much larger number of instances, it entirely fails; and under these circumstances the iodide of potassium and the bromide of potash have been recommended. Mr. Twining says he has given the tinct. of iodine in six cases of tumid spleen, and is satisfied it is of no use in that disease. Dr. Williams, however, in his *Elements of Medicine*, states, that in one instance, he has exhibited the iodide of potash in doses of gr. viij. ter die with most complete success. There are cases, therefore, to which it is applicable; but it must be admitted it more commonly fails. The same physician has given four cases of enlarged spleens in which the bromide of potassium was eminently beneficial, and restored the patient, curing his dropsy as well as the enlargement of the spleen. As no other remedy is at present even suggested for the cure of this intractable disease, the bromide of potash well deserves a further trial. The dose is gr. v. to x. ter die, out of camphor mixture.

Nephritis

Is an inflammation of the kidneys. This disease, in an acute form, is extremely rare; for in the returns of the causes of death for England and Wales in 1838, only 157 cases, and in 1839, only 139 cases of nephritis are mentioned as having proved fatal in those years. Chronic affections of the kidney, however, are extremely common; and taking dropsy as very generally connected with diseased kidney, it is quite plain that the deaths from simple organic affections of these glands amount not only to an infinitely larger number than has been mentioned, but form a considerable portion of the general mortality.

Remote Causes.—The kidney is acted upon by some morbid poisons, as the small-pox, but they are few in number, and rarely produce extensive mischief. A great number of substances, however, as alcohol, cantharides, turpentine, rhubarb, neutral salts, &c., are carried to the kidneys, and consequently must produce abnormal action, and sometimes disease of these organs. There is likewise hardly any disorder incident to the human frame which does not modify the urine, and consequently affects the kidney. Every atmospheric change or alteration of temperature affects the secretion of the skin, and consequently of the kidney. Most moral affections also, as hysteria, grief, or other depressing feeling, produce a similar effect. Many local diseases likewise, as diseased states of the bladder, urethra, or the presence of calculi, are equally remote causes of nephritis.

Predisposing Causes.—Children, except they labour under calculi, are rarely subject to nephritis. These affections are consequently most commonly met with in the adult, and in these after the age of 30.

Pathology.—The substance of the kidney is liable to the diffuse, to the suppurative, and to the ulcerative inflammations.

The previously healthy kidney, when diffusely inflamed, is loaded with dark venous blood, is softer than natural, and is considerably enlarged. Externally its surface is dotted with a number of dark red points, often surrounded with a vascular net-work, while internally the cortical substance is more loaded than the medullary, and is also dotted with dark points, which Rayer supposes to be the Malpighian bodies injected. The mucous membrane of the pelvis of the kidney is also red and injected.

The diffuse inflammation may terminate by resolution, when it leaves the kidney probably harder than usual; but it may proceed, and suppuration take place, which, according to Rayer, is most frequent in the cortical substance. The pus effused may form one or more abscesses, which vary in size from a pin's head to a large cyst, formed by the entire destruction of the kidney. Rayer has given some drawings which he conceives to represent purulent infiltration of the substance of the kidney.

Besides the substance of the kidney being inflamed, the mucous membrane lining the pelvis and tubuli is also often the seat of the diffuse, the adhesive, the suppurative, and the ulcerative inflammations, and these inflammations have received the name of *pyelitis*, from πυελος, pelvis.

Diffuse inflammation of the mucous membrane of the kidneys is marked by redness more or less general, and of a deep venous colour of those tissues, and this redness is sometimes increased by small patches of ecchymosis. This inflammation may terminate by resolution, or it may proceed; and Rayer has given two plates in which lymph has been thrown out at its free

surface. In other cases pus is secreted, and in acute pyelitis, says the same authority, we can sometimes determine the presence of pus, either by the eye or by the assistance of the microscope, in the urine contained within the pelvis. Ulceration is a possible condition of pyelitis, but is seldom met with in the acute forms of this affection.

In the chronic forms of diffuse inflammation of the mucous membrane of the pelvis, the appearances are for the most part similar to those of the acute forms, but the mucous membrane both of the pelvis and calices is more sensibly thickened, so that those canals are sometimes transformed into fibrous cords. If pus be effused and retained, the calices and pelvis often become enormously dilated, while the substance of the kidney is atrophied. Rayer has given instances of chronic abscesses of the kidney so large, that they have communicated with the liver, or ruptured into the duodenum, or have adhered to the diaphragm, and burst into the bronchi. He has also seen them extending downwards to the cæcum, or even to the crural arch; likewise opening in the back, and discharging urine and pus through a lumbar fistula, and these latter are instances of ulceration of the substance of the kidneys.

It will be seen also, from the above instances, that the mucous membrane of the kidneys is liable to ulceration, especially if the kidney be the seat of a calculus; and that these ulcers sometimes heal, is manifest from our occasionally meeting with cicatrices.

Rayer mentions having seen in acute as well as in chronic pyelitis the pelvic membrane covered with an eruption of transparent vesicles, like sudamina. Andral has likewise seen a vegetation, red and soft, with a broad base, of the size of a small nut, growing from the same tissue.

On examining persons who have died of pyelitis, or extensive abscess of the kidney, we often find sand, gravel, or a calculus, which has laid the foundation of the disease, contained either in the pelvis or calices. When calculi form, they are sometimes small, sometimes of great size, and sometimes composed of many small ones agglomerated together. Their form is extremely irregular, generally taking that of the dilated pelvis and calices in which they are retained, and from this cause are often knobbled, or branch out like a piece of ginger.

The kidneys are sometimes notably *hypertrophied*, still retaining their form, structure, and appearance. This hypertrophy may take place in one or both kidneys, and in every case in which one kidney is either atrophied or wanting, the remaining one is as a general law hypertrophied, and has often weighed eight or nine ounces, or more than two healthy kidneys. Hypertrophy of the kidneys often accompanies diabetes.

The kidneys are likewise sometimes *atrophied;* and this affection may be general, or limited to the cortical or to the medullary substance. Bartholin has seen them no bigger than a chestnut. Morgagni has likewise mentioned several cases of atrophy of the kidneys, and in one the kidney had scarcely the size of the surrenal capsule; and Rayer mentions a case in which the right kidney had not one-eighth part of its ordinary volume, although the calibre of its renal artery was nearly equal to that of the left kidney, which was of the ordinary size. The most remarkable partial atrophy of the kidney is the disappearance of large portions of its tubular structure, so that in some instances hardly a trace of it is left, a circumstance extremely frequent.

The pelvis and calices of the kidney are sometimes greatly dilated, without the slightest trace of inflammation. This state of the kidney is usually caused when an obstacle occurs to the passage of the urine, either in the urethra, bladder, or at the mouth of the pelvis itself. This state has been termed dropsy of the kidney or hydro-renal distension. At first the distension is trifling, but if it proceeds, a pyriform tumor forms in the fissure of the kidney, whose apex is downwards. Rayer has given a plate of one of monstrous dimensions; and Tulpius speaks of having seen one as big as the urinary bladder; Frank of one that filled the abdomen, and weighed 60 lbs. In Rayer's case, the kidneys were so compressed as to be no larger than a haricot bean.

Besides dropsy of the kidney, *serous cysts* very often form in the substance of the kidney. These cysts are almost always filled with a serous fluid, which, analyzed, gives albumen and the usual salts of the blood. These most commonly form in the cortical substance, are lined with a serous membrane, and vary in number from one to three or four, or even a greater number. In size also they vary from a pea to a goose's egg. These cysts also sometimes form in the surrounding cellular tissue, and sometimes with great rapidity. Mr. Cæsar Hawkins gives the case of a child run over at the end of September, and, on the 1st of December, a cyst had formed, which was punctured through the abdominal muscles, when 18 ounces of fluid were drawn off. The cyst filled again, and the child died on the 25th of December.

In a few instances cyst is contained within cyst; but this form is generally supposed to denote the presence of *hydatids* in the kidney.

The most frequent as well as the most remarkable of the diseases of the kidney, is that which is termed the *granular* or *Bright's kidney*. The disease known under this name has many varieties, and these varieties have been considered by some authors as so many distinct diseases, while others esteem them to be only so many different stages of the same disease. These Dr. Bright divides into three, Martin Solon into five, and Rayer into no fewer than six stages.

Those who contend for this difference of stages affirm that, in the first stage the kidneys are unusually large, flabby, loaded with dark venous blood, and hardly in any respect differ from what is observed in diffuse inflammation, except that externally the kidney has a granular appearance, caused by the deposition of a dark reddish yellow matter.

The second supposed stage is marked by the granular matter penetrating still deeper into the cortical substance, and which gradually increases till it invades the whole of the medullary substance of the kidney. This granular substance is of a greyish-red, or greyish-yellow colour, and has in many cases something of a *cheese*-like appearance. The kidney is now sometimes larger than natural, sometimes of the natural size, and sometimes, though rarely, diminished. Its consistency also varies, for if enlarged it is commonly softer than the healthy kidney, but if diminished it is for the most part firmer. Its colour, viewed externally, is sometimes a pale tint of the natural hue, but more commonly it is of a greyish-yellow or yellowish-red, and *mottled*. Its surface is also strongly granulated, and even rough. In this state, if the kidney be now injected, the matter of the injection does not, according to Dr. Bright, penetrate the cortical portion.

Elementary Principles of Medicine.

The last stage is marked by the morbid granular deposit, besides invading the medullary substance, attacking the tubular portions of the kidney, so that the tubuli are often to a very considerable extent obliterated, and perhaps, with the exception of a single pencil of that structure, is entirely converted into one homogeneous degeneration. The kidneys are now, in some instances, of their natural size, but more generally they have contracted, and are smaller than usual; their surface is also now lobulated, pale, and granular, resembling the roe of a salmon. Their consistency also is sometimes softer and sometimes harder than natural; and Dr. Bright speaks of some instances in which they cut like cartilage.

Another disease of the kidney is INDURATION of its substance; and this alteration of its structure is consistent with its being enlarged or diminished in size, but more commonly the latter. Its colour also may be either natural or else darker or paler than usual. The induration may be partial or general, and when partial its most common seat is the tubuli, which often acquire an almost cartilaginous hardness.

The kidney is sometimes found softened, or in a state of *ramollissement;* and this alteration of the kidney, according as the organ is healthy or unhealthy, may be either pale or of an intensely deep red or liver colour.

Andral says, "I have found the substance of the kidney, whether pale or yellow, grease the scalpel." It is by no means unusual, however, to find STEATOMA of the kidney, and considerable portions of its substance either invaded by or else converted into fat.

Periphrenitis is an inflammation of the adipose, fibrous, and cellular tissue surrounding the kidneys. These parts are sometimes found simply injected, sometimes the seat of abscess, and sometimes gangrened. A remarkable case is narrated by Dr. Turner, in the *Transact. of the College of Physicians*, which destroyed a lady near 30, and yet, strange to say, she neither experienced any pain or difficulty in making water, neither was she aware of her urine being less copious than usual.

Symptoms.—Acute nephritis is an extremely rare disease, so that there is much doubt whether we are thoroughly possessed of its symptoms. Those mentioned by Dr. Baillie are as follows; but it will be seen that they are almost identically the same as those observed in the passage of a calculus, which makes it doubtful whether that eminent physician ever saw the disease. "When the kidneys," he says, "are inflamed, more or less pain is felt in the region of these glands, and the pain commonly shoots along the ureters. There is a sense of numbness down the thigh, and in the male there is often retractation of the testicle, or a feeling of pain in it. When one kidney is affected these symptoms are only felt on that side. The urine is voided frequently, and is sometimes of a pale, but more commonly of a deep red colour. The stomach sympathizes with this state of the kidneys, for it is affected with sickness and vomiting. The bowels are at the same time often costive, and subject to colicky pains. These symptoms are accompanied by more or less fever." "When pus is formed it may be known by its being mixed with the urine." Mr. Stanley's cases by no means bear out this description. He gives the case of a man who had retention of urine in consequence of a gonorrhœal discharge being stopped by injections. In this instance the kidneys were found extremely vascular and soft, with numerous minute depositions of pus throughout the corticular and tubular parts, and the infundibula and the pelves were likewise filled with pus. The principal symptom was severe pain at the fifth lumbar vertebra. In another similar case, but not quite so acute, the kidneys were found so dark-coloured as to be almost black, and at the same time remarkably flaccid. This patient died paraplegic, the loss of motion being complete, and that of sensation nearly so.

If nephritis passes to a chronic suppurative state, the pain in the loins is often severe, the appetite impaired, while pus is found, and often to a considerable amount, in the urine; and if a calculus or gravel be the immediate cause, the urine often contains large portions of those substances mixed with blood.

The other forms of chronic disease of the kidney have not as yet been distinguished from each other. For the most part they present no local symptoms, but give rise to dropsies, having no specific differences. The granular kidney, however, is always accompanied by albuminous urine, by universal anasarca, an impoverished state of the blood, and the many other singular phenomena of that disorder. It must be remembered, however, that although granular kidney is constantly acccompanied by albuminous urine, yet albuminous urine may accompany every structural disease of the kidney, or result from a mere disease of function.

Diagnosis.—Diseases of the kidney are to be distinguished from those of the bladder by the presence of dropsy, and also by the fact that the bladder is infinitely less liable to be the primary seat of disease than the kidney.

Prognosis.—Acute affections of the kidney are in all cases of grave prognosis. The chronic forms of these affections are perhaps consistent with life, but in every case they greatly impair it, and are ultimately the cause of premature death. When dropsy is established the patient recovers with difficulty, and is then liable to relapse.

Treatment.—The treatment of acute nephritis must be according to the ordinary laws of inflammation, or by bleeding, evacuants, and opiates. The young practitioner, however, should be warned that blisters in these cases are dangerous, and should be avoided. The neutral salts, with opiates, are perhaps admissible; but most writers recommend castor oil, manna, or other purgative substances which do not act so immediately on the kidneys. In chronic suppuration of the kidney it is plain that bleeding must be omitted. The other forms of diseased kidney, if they are ever cured, yield to the treatment pointed out for the cure of the dropsies which depend on them.

OF URETERITIS AND OF CYSTITIS.

Ureteritis and Cystitis are inflammation of the ureter and of the bladder; but being parts so intimately connected and so rarely affected, it is thought best to unite them together. 138 cases are said to have died of these diseases in 1839.

Remote Causes.—The bladder or ureter is rarely acted upon by morbid poisons; and Louis has shown that ureteritis and cystitis rarely co-exist with diseases of other parts; for out of 500 persons dead of other diseases than those of the urinary organs, there were only

five or six in which the mucous membrane of the bladder was injected, and only one in which a small ulcer of the same part was found; a remarkable circumstance, considering how frequently retention of urine is a symptom at the close of many diseases. It is well known, however, that cantharides, turpentine, and perhaps some other substances, act specifically on the bladder, and produce inflammation. Calculi, together with diseases of the kidney, are the most frequent causes of this affection.

Predisposing Causes.—The parties who suffer from these affections are principally adults and children who labour under calculi.

Pathology.—The mucous membrane of the ureter is liable to the diffuse, to the adhesive, to the ulcerative, and to the suppurative inflammations, and these may be acute or chronic.

The ureter is occasionally found to be highly vascular, and of a deep venous colour after the passage of a calculus; and this is supposed to prove that the mucous membrane of this canal is liable to diffuse inflammation. There are repeated instances of adhesive inflammation of this canal. Andral quotes a case in which all the internal surface of the ureter was covered with a layer of lymph similar to the membrane in croup; and in some rare instances the ureter has been found obliterated or transformed into a fibrous cord. A transverse canal has also in some instances been found connecting the two ureters; but whether this is a congenital formation or a consequence of a temporary obstruction of the ureter, is problematical. There are other well-marked effects of adhesive inflammation of the ureter, as when the delicate coats of this canal are increased, as in cases of severe chronic disease, to 4 to 6 lines in thickness. Suppurative inflammation also sometimes takes place in the ureter, and without breach of surface; for, in a case in which a calculus was found in the ureter, Cruveilhier says the part above the obstacle was filled with blood, *pus*, urine, and gravel. The different inflammations that have been mentioned sometimes terminate in ulceration, and the ulcers in some cases heal, for cicatrization of the mucous membrane has been met with. In other instances the ulcerated part has ruptured, and the patient has died in consequence of effusion of urine into the surrounding parts.

The ureter is occasionally much hypertrophied, especially if the bladder be diseased. It is also often greatly dilated, especially when a calculus is retained, or else when the bladder is so distended from the retention of urine as to obliterate the valvular fold which in health prevents the return of the urine towards the kidney. In these cases it is often so enormously dilated as to equal the size of a child's arm, and sometimes, according to Rayer, till it ruptures, the walls being from their great distension in a state of atrophy. In chronic inflammation the walls are often greatly thickened and *indurated*. No case is known of *ramollissement* of this canal.

The mucous membrane of the bladder is likewise liable to the diffuse, the serous, the adhesive, the suppurative, and the ulcerative inflammations, and these may be either acute or chronic. These inflammations may extend over its whole cavity, or be limited to some portion of it, and the part most frequently inflamed is that near and around the neck of the bladder. In this it follows the law of all hollow organs, or that it is most liable to be diseased at its orifices. There is also another reason for this part being more frequently attacked than the rest, or the occasional extension of inflammation of the urethra to this part.

"It is well known," says Dr. Baillie, that "the inner membrane of the bladder in the dead body hardly shows any vessels which are large enough to carry red blood in its natural state;" but when *diffusely* inflamed, it is crowded with a prodigious number of extremely fine blood-vessels, and among them may be seen small spots of extravasated blood. This state has many degrees, and the colour is usually of a venous red, while, in addition to this, the coats of the bladder generally are thickened. It may terminate by resolution, or it may pass into serous inflammation, or catarrh of the bladder. The mucus secreted in this latter disease is at first small in quantity and extremely fluid, but is deposited as the urine cools. At a further stage of the disease it becomes abundant and thickens, equalling or surpassing the urine in quantity, and which now resembles thick gruel, and is often mixed with blood, or gravel, or both. Andral has twice seen the internal surface of the bladder coated with lymph more than a line in thickness, and similar to the false membrane of croup. The lymph thus effused sometimes becomes organized; and in this manner calculi have become encysted and removed out of the reach of the sound. Dr. Baillie tells us that Dr. Ash met with a case in which the urinary bladder was divided (probably from this cause) into two chambers, which communicated by a small aperture with each other. The upper chamber was usually much distended with urine, so that a round tumor could easily be distinguished by the touch above the pubes.

Inflammation of the mucous membrane of the bladder often terminates in suppuration, and pus to a considerable amount may then be passed. Occasionally, instead of suppuration taking place at its free surface, an abscess forms: in either case ulceration may take place, sometimes superficially, and sometimes so burrowing as to perforate the bladder, and form a communication between it and the neighbouring parts, as the cavity of the abdomen, the rectum, or the vagina. When the communication is formed with the general cavity of the abdomen, the urine escapes into it and produces general peritoneal inflammation.

The mucous membrane of the bladder is liable to similar chronic inflammation, sometimes retaining its normal colour, and at other times being grey or *ardoisée*, brown, or black; and it has often acquired a double or even triple thickness. The follicles also, which are hardly visible in health, are now enlarged, and extremely palpable to sight. One of the most ordinary changes, however, in the bladder from its natural structure is hypertrophy of its muscular coat. In a natural state the muscular coat of the bladder, when it is moderately distended, consists of thin layers of muscular fibres running in different directions, and probably less than the eighth of an inch in thickness. The muscular coat of the bladder, however, is found in some cases half an inch thick, owing, for the most part, to its efforts to overcome some resistance, as an enlargement of the prostate, or the presence of a calculus or a stricture in the urethra to the passage of the urine. In some instances these efforts of the bladder to evacuate its contents have led to the mucous membrane being protruded through the intermuscular spaces, forming a pouch or hernial sac, in which a small calculus has been embedded, but this form of disease is extremely rare. The mucous coat of the bladder is also often greatly hypertrophied.

Elementary Principles of Medicine.

The bladder may also be atrophied, so that when distended it is semi-transparent, and this may result from an atrophy of all its coats, or from a faulty development of the muscular coat. In some cases of congenital malformation the anterior portion of the bladder is wanting, and this is generally coincident with a defective state of the muscles of the abdomen, which are imperfectly united to the pubis. The bladder has also in some instances been altogether wanting.

The bladder is sometimes much *indurated* from chronic inflammation, while in other cases it has been found to have undergone the process of *ramollissement*, similar to that incidental to the stomach, when the slightest traction is sufficient to cause a rupture, and sometimes give rise during life to spontaneous perforation.

Dr. Baillie mentions having seen one case of *polypus* of the bladder so large as to fill up the greater part of its cavity. It was very irregular in shape, consisting of various projecting masses, but seemed pretty firm in its texture. Some of these tumors, says Andral, are hard and void of every trace of a vessel, while others are soft and vascular, and others again seem mere prolongations of the mucous membrane.

The bladder is sometimes enormously *dilated*, so as to occupy the lower part of the cavity of the abdomen, and to contain several quarts. It is in other cases so contracted as hardly to have any cavity, and will scarcely hold a few tea-spoonfuls.

Symptoms.—The symptoms of inflammation and of the other diseases of the ureter are probably the same as those of the similar diseases of the bladder, except, perhaps, that the pain is more strictly lumbar; and when these canals are greatly enlarged, it is possible they may be felt through the walls of the abdomen.

The symptoms of inflammation of the bladder are pain felt in the perinæum and above the pubes, accompanied with a fulness or swelling, also frequent attempts to make water, which is evacuated in small quantities and with great pain, or there is a total retention of urine, with a strong desire to void it. The rectum is affected, from its connexion with the bladder, with tenesmus, and the stomach likewise takes part in this disease, being affected with nausea or vomiting. In some cases these symptoms are accompaned with much constitutional irritation and by delirium. When pus is formed, it will be seen mixed in the urine evacuated. The slighter form of the disease, or cystirrhœa, is characterized by milder symptoms, which consist principally of local pain and irritation, and by the urine being loaded with mucus, which sinks to the bottom of the vase, mixed with a large quantity of sandy precipitates either of the phosphates, of the urates, or of both. It is remarkable that on this form of disease subsiding, that the patient often falls from disease of the lungs. The symptoms of the other forms of disease of this viscus vary only in degree from those which have been mentioned.

Diagnosis.—When the kidneys and ureters are diseased the bladder very constantly sympathizes with those diseases; and the affections of the bladder being much more painful than those of the ureters and pelvis of the kidneys, the sympathetic affection of the bladder is often mistaken for the primary disease. Morgagni first pointed out this fact, and gives a case in which, from these sympathetic pains, it was believed that the patient laboured under disease of the bladder; yet after death the bladder was found perfectly healthy, while the kidneys were extensively diseased, and filled with large calculi. Lowdell and also Howship give similar instances of the kidneys being diseased, when the symptoms of the bladder were so prominent as to be mistaken for the primary disease.

Prognosis.—The result of the acute forms of inflammation of the bladder or ureter is generally favourable. The chronic forms of cystitis, as of cystirrhœa, are more formidable, and often ultimately cause the death of the patient.

Treatment.—Bleeding does not greatly influence inflammatory affections of the bladder; but some authorities nevertheless direct moderate bleeding and purging, together with opiates, diluents, and the warm bath, as the best means of curing the very few acute affections of this viscus that we meet with. Chronic inflammation of the bladder, and especially cystirrhœa, is of very difficult cure, and often our best-directed efforts are unsuccessful. The state of the urine is perhaps one of the surest guides in our attempts to cure the patient; and if the urine be acid, the best medicines are the neutral salts or the pure alkalies, with opiates; while, if the urine be alkaline, or greatly loaded with mucus, the mineral acids are of the most service, combined with an opiate. Thus the infusi rosæ c. acidi sulph. dilut. ♏ij. to ♏v. c. magnesiæ sulphatis ʒj. c. tinct. opii ♏iij. to ♏v. 6tis horis is one of our best and most useful remedies.

The remedies which have been mentioned, though highly useful, yet frequently fail, and, in such cases, tonics often succeed, and of these salicine is the best, and gr. x. ter die vel 6tis horis may be given with great chances of success. It must be admitted, however, that much difference of opinion prevails as to the best tonic remedy, some preferring uva ursi, others pariera, others the turpentines, as the Canadian balsam, and others again the inf. diosmæ.

Of Peritonitis.

Peritonitis is an inflammation of the serous membrane lining the abdomen, and covering the viscera contained in its cavity.

This disease was known to the ancients. It is not common; and if we take the numbers reported to have died of this disease, of hernia, and also of intussusception, the deaths from the two latter being generally caused by peritonitis, we find they amounted to only 757 cases in 1838, and to 895 cases in 1839, in England and Wales, which gives one death in about 370.

Remote Causes.—Inflammation of the peritoneum is caused by a few morbid poisons, as the paludal poison, and the poison of scarlet fever. Mechanical violence, as the kick of a horse, also the operation for hernia or the stone, or that of paracentesis, are frequent causes. Rupture of the intestine from ulceration, or the bursting of an abscess, or of an aneurismal tumor into this cavity, is also another class of causes. Errors of diet, and especially frequent intoxication, is an occasional cause, the disease termed *gin-colic* being a chronic inflammation of the peritoneum. Sudden and great changes of temperature are also causes, especially in women at the period of menstruation. Intussusception of the intestine, or strangulation of the intestine from hernia, or other accident, are also occasional causes. As a secondary disease it is frequently produced by hepatitis, splenitis, enteritis, and by cancerous and tubercular deposits in the subcellular tissue.

Predisposing Causes. — Children sometimes die of

this affection after scarlatina, and also from strangulation of the intestines in consequence of congenital malformations. Peritonitis, however, is most common between the ages of 20 and 40. Women appear to die more frequently from it than men; and in 1838 the proportion was 57 men to 117 women, while in 1839 the ratio was 68 men to 115 women, or nearly in the ratio of two to one. This greater liability to peritonitis in the female sex arises perhaps from the great sympathy between the uterus and the peritoneum, a sympathy which is strongly marked, not only at the period of menstruation, but also at the time of parturition. At the latter period, in the opinion of many excellent practitioners, the remarkable fact occurs of puerperal peritonitis becoming contagious, and that the contagion spreads among puerperal women only.

Pathology.—The peritoneum is liable to the diffuse, the serous, the adhesive, the suppurative, the ulcerative, and to the gangrenous inflammations, and these may be either acute or chronic.

Acute inflammation of the peritoneum, as of all serous membranes, begins in the connecting cellular tissue, which becomes red and injected, and at length the same phenomena pervade the serous membrane itself. The colour of this membrane, when inflamed, like that of all serous membranes, is a bright arterial scarlet hue; the membrane being first dotted with a number of small red points, which become confluent, and form streaks and patches which in their turn coalesce; or a small central nucleus of inflammation may form and spread till the whole extent of the peritoneum is one entire bright scarlet. In addition to the redness, some interstitial deposit accompanies diffuse inflammation of the peritoneum, so that this membrane loses its transparency, and is thickened. The consistency also of the subcellular tissue is greatly impaired, and rendered easily lacerable, so that the peritoneum is now capable of being detached in considerable portions. This inflammation may terminate by resolution, or it may proceed, and serum be poured out, when serous inflammation is established. The quantity of serum effused may be trifling, not exceeding a few ounces, but occasionally it is large, fills the cavity of the abdomen, and constitutes inflammatory dropsy.

The next degree of peritonitis is the adhesive inflammation, when lymph may be thrown out oftentimes so loose as to float unattached in the serum, or it may be of such consistency as to unite opposite parts together, and of such extent as sometimes to form an adventitious membrane, covering the entire of the abdominal walls as well as the whole of the intestines. The period at which organization of the lymph thus effused begins has been determined by Mr. Hunter to be in about 24 hours. If the disease proceeds, pus is effused, sometimes not to a greater amount than a few ounces, but in other cases it amounts to many pints, or even fills the whole of the abdominal cavity. Ulceration of the peritoneum is infrequent, and generally takes place from without inwards, as from a perforating ulcer of the small or large intestines or from the rupturing of an abscess or other tumor. The peritoneum is also liable to mortification, either from high inflammatory action, or else from strangulation, as in hernia. In this case the part is of a reddish-purple or black, and is easily torn. The different acute inflammations described have been mentioned as though succeeding each other; but in many instances all these different forms co-exist in different parts of the peritoneum at the same time, and perhaps have been irregularly set up.

The chronic forms of peritonitis may be *chromatous* or *achromatous*, and the latter present some of the most curious phenomena incident to this tissue. The peritoneum, for instance, is often found to be white, opaque, and thickened, the subcellular tissue having become almost incorporated with the membrane, so that together they sometimes form a substance an eighth of an inch in thickness. The tissues are also now indurated, and much less easily detached; and, taking all these circumstances together, they show that the peritoneum must have been the seat in all probability of a chronic achromatous inflammation. A similar achromatous state of parts is often seen when serum is thrown out; and also when the intestines are found glued to each other and to the cavity of the abdomen by adhesive inflammation. It is remarkable, also, that pus in sufficient quantity to fill the abdomen is sometimes likewise found effused without the peritoneum being discoloured. It is from this process, also, that we occasionally find large cysts attached to the liver, or other abdominal viscus, filled with serous fluid.

The peritoneum is sometimes the seat of chronic *chromatous* inflammation. Thus we sometimes meet with chronic red diffuse inflammation, with chronic red serous inflammation, and with chronic red adhesive inflammation. The latter may be of various extent, and sometimes is so considerable that the false membrane which is formed covers not only the walls of the abdomen and of the viscera, but also the whole of the intestines, and even slips down between the convolutions. It is of a muddy brown or rusty colour, and usually contains much melanic matter, both in the web and at its free surface, and also much tubercular matter in the sub-cellular tissue. The membrane thus formed, like all new adventitious parts, readily runs into disease, and from this cause we often find the abdomen filled in these cases with serum or pus. In these chronic forms of chromatous peritonitis the subcellular tissue is less lacerable than in health, and Louis also mentions that parts which have been the seat of chronic peritonitis have a strong tendency to contract. Thus he has found the omentum corrugated, contracted, and folded up under the greater curvature of the stomach, till it has been so reduced as to be hardly recognizable and merely rudimentary. Besides the omentum, he has found the mesentery also contracted, that membrane being more or less shortened, till the intestines have been drawn up to the spine, and with such force, that an existing hernia has been sometimes completely reduced. The intestines themselves are also often contracted, and more frequently perhaps in their length than in their calibre, and in extreme cases they have been found to lose half or nearly so of their dimensions, when the valvulæ conniventes have been consequently drawn close to each other.

Experience has also shown that, although the structure of the peritoneum appears to be uniformly the same, yet certain parts of it are more liable to inflammation than others, as the convex surface of the liver or spleen, the right iliac fossa, the surface of the small intestine, and in females the broad ligaments, the Fallopian tubes, and the parts immediately adjoining them, as also the space covering the rectum and bladder. The parts the most rarely affected are those covering the stomach, bladder, the omentum, and the mesentery. It will be seen that the liability of different parts of the

peritoneum to inflammation is in proportion to the liability of the organs they cover to become diseased, and that these partial inflammations are for the most part the result of sympathetic irritation. Dr. Hodgkin is of opinion that peritoneal gastritis is little more than a nosological distinction, and scarcely exists in nature. As his authority is great, it may be as well to mention that a man was brought into St. Thomas's, after having received a kick from a horse on the abdomen, below the umbilicus. He shortly died. The part of the abdomen where the injury had been received was not even discoloured, but there was extensive ecchymosis among the muscles beneath. The peritoneum was diffusively, adhesively, and suppuratively inflamed in different parts, while the peritoneum covering the stomach evidently partook of the general inflammation. A rupture also existed of the intestines.

The peritoneum is liable to become indurated, and more especially in those parts covering the spleen. There are two specimens in the Museum of St. Thomas's Hospital, in one of which the peritoneal coat of the spleen is cartilaginous, and in the other bony matter is largely deposited. It appears that this state is sometimes general, for " in one case," says Dr. Baillie, " I have seen a great many cartilaginous excrescences growing from the peritoneum. They are of a small size, most of them not larger than a garden pea. They were a little softer than the cartilages of the bones, but had the true structure of cartilage," p. 132. Ramollissement of the peritoneum is frequent, but not so frequent as of the mucous membrane.

Hydatids have occasionally been found in large numbers swimming freely in the fluid of ascites. They more frequently, however, according to Dr. Baillie and Dr. Hodgkin form beneath the peritoneum, and give rise to tumors, sometimes of an enormous size. Mr. Abernethy mentions having found a fatty tumor attached to the peritoneum.

Symptoms.—Peritonitis may be acute or chronic, partial or general.

Peritonitis is occasionally ushered in by some previous shivering and fever, but in many cases there are no preliminary symptoms.

If acute peritonitis is of that intensity which may terminate by resolution, or by effusion of serum, or of lymph, the patient complains of a severe pain in the abdomen, which is increased on pressure; he lies on his back, fearing to move. His pulse is from 90 to 120, and in proportion as it is frequent, so is it smaller; his tongue is coated, and his bowels constipated or regular. If serum be effused, that event can be determined by the fluctuation; or if lymph, by a rubbing sound heard under the stethescope. The course of these forms of acute peritonitis varies from a few hours to 10 or 14 days.

When acute peritonitis, however, is of that intensity that it will terminate in effusion of pus, the symptoms are infinitely more formidable. The pain in the abdomen is the severest that human nature can suffer. The patient indeed lies on his back, but his legs are drawn up and bent so as to relax as much as possible the abdominal muscles. Still, although the pelvis is fixed, he is restless, unable to bear the slightest pressure, not even the weight of a sheet, and is incessantly tossing his arms about in every direction. The state of his tongue and bowels are similar perhaps to what have been described, but his pulse is excessively small and rapid, varying from 130 to 150, while his stomach is often distressingly affected by retching and vomiting. These symptoms perhaps continue without intermission for 24, 48, 72, or more hours; when, with or without some previous shivering, pus is effused, and the pain from being agonizing is now bearable. The subsidence of the pain, however, is not followed by any amendment; on the contrary, a most alarming collapse succeeds, a cold clammy sweat breaks out over the body, while hiccup, and a pulse hourly increasing in frequency, proclaim the entire hopelessness of the patient surviving beyond a few hours.

When acute peritonitis is confined to the liver or other organ, the pain is often limited to that part, while the other symptoms vary according to the severity of the affection and the organ attacked.

Chronic peritonitis often takes place to a great extent, and without any great amount of suffering. The symptoms are rather those of abdominal soreness and uneasiness than of pain, together with a full but sometimes rapid pulse. The intestines indeed may be glued together, and sometimes pus has been found effused, without the patient suffering more than in ascites. When chronic peritonitis is partial, as of the liver or spleen, the patient often experiences a dragging pain, which is increased by change of position, and arises from the parts being suspended by adhesion.

Diagnosis.—The pain being greatly increased on pressure, and the pulse rapid, together with the general uneasiness and evident danger of the patient, readily distinguish peritonitis from colic or leucorrhœal pains.

Prognosis. — Partial peritonitis often terminates without in any sensible degree impairing the general health; thus we often find extensive adhesions of the liver without any marked symptoms. In every case, however, in which the structure of the peritoneum is thickened or otherwise impaired, the patient may recover, but generally relapses and dies of dropsy; for the peritoneum, like all other serous tissues, appears to possess little power of restoration after disease. Every attack of acute inflammation is of grave prognosis, and when pus is effused, it is uniformly fatal; neither will the patient recover if the peritonitis is caused by subperitoneal tubercles.

Treatment.—The treatment of acute peritonitis must be active, and there are few diseases in which the life of the patient is more completely in the hands of the practitioner. The activity of the treatment must be proportioned to the amount of pain and the rapidity of the pulse. In the milder forms of the disease, when the pain is bearable, and the pulse steady, and under 100, one bleeding from the arm, or 20 leeches over the abdomen, together with pil. hydrargyri, gr. v., n. m., and moderate purging with neutral salts, combined with an opiate, are sufficient to effect a cure. In the severer forms of disease, and with a tendency to effusion of pus, all these modes of treatment must be combined, and carried to a considerable extent. Thus 16 to 30 ounces of blood should be taken from the arm, and 30 leeches applied to the abdomen, and a poultice afterwards to encourage the bleeding. Bleeding, however, is not enough, for sometimes when carried so far as to affect the patient's head, and to cause temporary insanity, the peritoneal inflammation is not subdued. It is necessary, therefore, to have recourse to mercury, and with a view to affect the mouth; and five grains of calomel, combined with half a grain of opium, so as to

give the patient some relief from pain, should be exhibited every four, six, or eight hours, according to the intensity of the disease. As soon as the mouth is affected the patient is relieved, and at this point the mercury should be omitted, and the patient moderately purged with neutral salts, combined with an opiate, and he often recovers.

The treatment of chronic peritonitis must be directed by the same principles; but we should be content with effecting a present alleviation of symptoms, and without attempting the removal of the mischief which has already occurred; for in patients that have laboured under chronic peritonitis, and survived many years, the peritoneum has still been found opaque, thickened, and silvery, so that in all probability these alterations are permanent.

The diet of the patient in the acute forms of peritonitis should be rigidly slops.

Of Inflammation, and other simple Organic Diseases of the Respiratory Organs.

Angina—Cynanche—*Sore Throat*—

Is an inflammation of the parts constituting the fauces; 659 cases are reported to have died in the year 1839 of quinsey, a popular name for sore throat.

Remote Cause.—The fauces are unquestionably acted upon by many morbid poisons, as that of scarlet fever, of small pox, of syphilis, and of influenza. Indeed the generally contagious nature of sore throats would lead us to believe that they are a class of disease determined in 19 cases out of 20 by some ephemeral or other morbid poison. In a few cases it appears to arise from cold, while a few more are caused by children accidentally drinking boiling water out of the spout of a tea-kettle. Occasionally it is produced by mercury or by mineral acids taken for the purposes of self-destruction.

Predisposing Causes.—Children from a very early period of life are exceedingly liable to sore throats; it is also very common in early adult age, but after 50 is comparatively infrequent. The sexes appear to suffer in nearly equal proportions. For in the year—

1838 . .	206	men and	206	women
1839 . .	353	,,	306	,,

are reported to have died from this affection. The seasons most pregnant with this disease are spring and autumn.

Pathology.—The common law of sore throats is that the poison produces fever, and after a few hours the patient complains of sore throat, which is of various intensity, the mucous membrane of the fauces being liable to the diffuse, the serous, the adhesive, and to the ulcerative inflammations, the latter sometimes terminating in gangrene. The substance also of the tonsils and uvula is likewise liable to all the inflammations that have been mentioned, and also to the suppurative inflammation, and these inflammations may be acute or chronic.

The mucous membrane of the fauces is often diffusely inflamed, when the patient complains of the throat being hot, rough, and dry, and, on examining the mucous glands they are found enlarged, the faucial membrane redder than usual, and all secretion stopped. This inflammation may terminate by resolution, or it may proceed, and it is probable, in a few cases, as in salivation, serum may be effused. More commonly, however, lymph is thrown out first in points, which sometimes coalesce, covering a considerable space. The more usual termination of these inflammations, however, is by ulceration at the surface of the membrane. When ulceration takes place, a slough forms, and is detached at various periods, or from a few hours to six or seven days. The ulcers are of very various forms, round or oval; sometimes entirely superficial, and then again deeply burrowing; and as inflammation of the tonsils is generally of a low character, they sometimes terminate in gangrene. The parts of the membrane most prone to ulceration are those covering the anterior and external surfaces of the tonsils and uvula, and also the posterior edges of the palate. When, however, the uvula is affected, it should be remembered that the ulceration may commence at the posterior surface, so that, in bad cases, that part may almost slough away unperceived, unless closely watched.

Besides the mucous membrane, the substance of the tonsils and uvula may inflame, and in this case the tonsils are red, loaded with blood, and moderately swollen, while the uvula is not only red and swollen, but greatly elongated, so that it rests on the base of the tongue, causing a most disagreeable sense of titillation. The disease may advance, and lymph or serum be thrown out, and in this case the tonsils are often greatly swollen, so as in some instances almost to occlude the passage of the fauces. The diagnostic symptom between the effusion of serum and of lymph is that, in the latter case, the tonsil remains often permanently enlarged, the lymph effused having been organized. In a very few instances an abscess forms in the tonsils, which ultimately ruptures and discharges a greater or less quantity of pus. It generally happens that both tonsils are affected, but occasionally the inflammation is limited to one tonsil.

In chronic inflammation of the tonsil the same phenomena are seen, but the course of the disease is slower, and the colour of the parts less vivid, and in general differing little from their natural tint.

The inflammation of the fauces, whether acute or chronic, not unfrequently extends to the pharynx; and its mucous membrane may in like manner take on the diffuse, serous, adhesive, or ulcerative inflammations. The inflammation also may commence in the subcellular pharyngeal membrane, and an abscess occasionally forms in that part. In a smaller number of cases, by an extension of the original disease, the epiglottis, glottis, and even the larynx are affected. In bad cases, as after severe scarlatina, it may also spread to the Eustachian tube, and cause suppurative or other inflammation of the mucous membrane of the internal ear. It sometimes also extends up the nasal passages, by which respiration through those passages is much impeded or rendered impossible, so that the patient breathes with his mouth open.

The tonsils have also been found to contain cysts, hydatids, and also to be the seat of calcareous formations.

Symptoms.—The different degrees of intensity which attend this affection allow us to divide sore throat into angina mitior and into angina gravior.

Angina gravior is usually preceded by some shivering and fever, which having lasted a few hours, the patient has the sensation of a sore throat. He finds deglutition difficult and painful, and what he attempts to swallow is perhaps rejected through the nostrils; his voice is altered, being hoarse and nasal, and he can hardly breathe through his nose; his ears are also painful, and he finds it troublesome to free his throat from the viscid matters

which adhere to it. The fever does not abate on the appearance of the local symptoms, but usually continues till the sloughs are detached, after which, if the case be properly treated, it declines, and the patient rapidly recovers. If, however, he be improperly treated, the patient often becomes delirious, showing under these circumstances that a poison still remains in the system, and acts on the brain and its membranes. Indeed the degree of prostration which often attends sore throat is so constantly out of all proportion to the local lesion, that it is impossible not to come to the conclusion that the angina very constantly results from a cause acting on the system generally. The fever, however, when the case is properly treated, generally subsides in three or four days, seldom lasts more than a week, after which the patient rapidly recovers, though in other cases that event may be delayed for two, three, or four weeks. This form of disease admits of two varieties, or that in which the tonsils are greatly swollen, and the ulcers for the most superficial, and that in which the tonsils are greatly loaded with blood, little swollen, and the ulcers deep and burrowing. The latter only is dangerous.

The symptoms of angina mitior differ merely in degree from the former, the fever being milder, and the tonsils only moderately swollen, and the ulcers always presenting a healthy appearance. This form of disease almost always terminates in a week or ten days.

The chronic forms of the disease are unaccompanied with fever, and when the result of simple inflammation, the tonsils are usually greatly enlarged, and the seat of one or more superficial ulcers, often covering its whole surface.

Diagnosis.—As the parts are visible, no mistake can possibly take place with respect to the existence of this disease, although it may be difficult to determine its exact cause.

Prognosis.—The instances are extremely rare in which a patient falls from angina.

Treatment.—The treatment of angina is extremely simple, and is determined by the state of the tonsils. When the tonsil, for example, is little swollen, there is hardly a case which resists four ounces of wine daily mixed with water, arrow-root, or sago, together with attention to the bowels, and this whether fever be or be not present. On the contrary, if the disease be neglected, or the patient be badly treated and bled, the fever is increased, delirium ensues, and the ulceration spreads, involving the possibility of its terminating in gangrene. Again, if the tonsil be greatly enlarged, a few leeches should be applied externally to the upper part of the throat, and these should be followed by a poultice and by gentle purging, with the mildest cathartics. On the contrary, should this state of parts be neglected, or the patient treated by tonics, the mischief is not so great as in the former case, but the fauces may be closed, or nearly so, and perhaps remain permanently enlarged, or an abscess may form, and in either event the condition of the patient is for a time rendered highly distressing, and in appearance even dangerous. Many practitioners are in the habit of using gargles, or blisters, or caustic; but these are for the most part unnecessary, often injurious, and partake greatly of the "nimia diligentia medicorum." In every case the patient should be strictly debarred from animal food till the throat be healed.

If, after the throat is healed, the tonsils should remain permanently enlarged so as to affect the speech, something should be done to effect their diminution; and perhaps the removal of a very thin slice is the most efficacious, for although often intractable to all other treatment, they frequently yield to this operation. Mr. Liston indeed states, that he has practised this method on public singers, and without in any degree impairing the compass, tone, or flexibility of their voices. When the uvula is permanently elongated from a similar interstitial deposit, astringent lotions are of little efficacy, and the removal of a portion either by the knife or ligature appears to be the only remedy.

Epiglotitis—Laryngitis—*Croup*—

Is an inflammation of the mucous membrane of the epiglottis, glottis, or larynx, and very commonly of all those parts.

It has often excited much surprise that a disease so distinctly marked in its symptoms should not have been accurately described before the middle of the XVIIIth Century, when Dr. Horne published a treatise on the suffocatio stridula, or croup, in 1765. This defect, perhaps only explicable on the ground of the little encouragement and fostering patronage with which the labours of the physician have been at any time cheered, is now supplied, for the disease is well known in this country, and is of great fatality; 4192 persons being reported to have died of it in England and Wales in the year 1839, or perhaps one child in twelve dies of this complaint.

Remote Cause.—There are some morbid poisons which unquestionably act on the larynx, as the paludal poison; also the poison of scarlet fever, of the hooping-cough, of the small-pox, and of syphilis. The annals of medicine also are rich in descriptions of epidemic and endemic croup, whence it would appear this latter affection was generally produced by some unknown poison. This is so much the case, that M. Baudelocque, physician to the Hôpital des Enfans, where 3000 cases are admitted annually, says, that sometimes for three years together he has not seen a single case, while M. Guersent's experience has been to the same effect. In other years, however, they have witnessed large numbers affected with this disease. These facts appear inexplicable from the mere play of atmospheric vicissitudes, and appear strongly to point to a specific cause. Sudden changes, however, from heat to cold, an easterly wind, the irritation of teething, are the other principally alleged causes of laryngitis. As a secondary affection, it arises in the adult from phthisis, from disease of the œsophagus, and from the pressure of an aneurismal or other tumor.

Predisposing Causes.—No age is exempt from laryngitis; but age greatly influences the occurrence of it. Perhaps the statement of Andral is an approximation to the truth. Thus, out of 288 cases he found 237 occur from birth to seven years old; and from this period up to 70, the deaths from laryngitis, taking decennial periods, were nearly in equal numbers in each division. As to the effects of sex, out of 543 children, 293 were boys, and 218 girls, the sex of 32 not being determined. Of adults that died of laryngitis in England and Wales in 1839, 40 were males and 22 females.

This difference of liability between the male and the female is probably merely owing to difference of exposure to the exciting cause. Mr. Farr calculates that deaths in towns from croup, compared with those from croup in the rural districts, are as 1 to 1·31.

Pathology.—The mucous membrane of the epiglottis, glottis, and larynx, is liable to the diffuse, the serous, the adhesive, to the suppurative, and to the ulcerative inflammations; and these inflammations may be either acute or chronic.

When the mucous membrane of the parts which have been mentioned is diffusely inflamed, its colour is in general of a deep venous red, while from some interstitial deposit it becomes thickened. This state of parts may occupy the whole larynx, or may be limited to its superior portion, to the chordæ vocales, or to the ventricular cavities; but when general and excessive, death, with all the symptoms of croup, has occurred, without the slightest effusion of lymph or other morbid product.

Diffuse inflammation may terminate by resolution, or it may proceed, and serum or pus be effused. These latter inflammations often take place in these parts, without any grave or serious accident arising to the patient, and almost without leaving any pathological phenomena behind them. When, however, the disease terminates by ulceration, or the throwing out of lymph, the case is often fatal, and the lesions extremely well marked.

Ulceration of the larynx is seldom seen in children, but is not unusual in the adult; and it is from this form of laryngitis that persons above the age of 10 years commonly die when afflicted with this disease. The number and size of the ulcers vary greatly; sometimes they are small and numerous, while, in other cases, there is only one, and that of considerable size, occupying the whole of the ventricle, or even a larger portion of the larynx. The base of the ulcer is generally the fibrous tissue, but sometimes it penetrates much deeper, involves the thyroid cartilage, and occasionally even perforates it, so as to produce a fistulous opening communicating externally, the voice being entirely lost, except an obturator be placed over the orifice. The principal seats of the ulcers are the epiglottis, the chordæ vocales, the ventricles, the angle formed by the union of the two thyroid cartilages, and posteriorly by the portion between the two arytenoid cartilages.

The most remarkable pathological phenomena of croup, however, are those caused by the *adhesive inflammation* terminating in the effusion of lymph, and the formation of a false membrane, a form of inflammation which, though sometimes seen in the adult, is nevertheless almost peculiar to children. The membranes thus formed vary much in thickness and consistency. Some are so thin that the mucous membrane is readily seen through them, while others are many lines in thickness, exceeding even that of the mucous membrane itself, and consequently opaque. With respect to their consistency, some are so little coherent, that they are almost diffluent, while others can be detached for a considerable extent without rupturing. The false membrane, though occasionally only partial, yet more commonly embraces the entire circumference of the larynx, forming a complete hollow cylinder, adapted to the walls of the larynx. The membrane is in most instances limited to the larynx, but in some cases it extends down the trachea to the bifurcation, while in a very few cases it reaches even to the minutest branches of the bronchi. M. Hussenot says, of 120 cases he examined, in 78 it did not extend beyond the larynx, while in 42 cases it invaded the trachea or bronchi. The membrane thus formed is, in a few instances, removed by the cough, but more generally it adheres with so great tenacity that Gendrin conceives that it can only be detached by a thinner and more serous secretion taking place from the mucous membrane beneath it, which loosens and displaces it. No well-authenticated case exists of this false membrane having been found organized.

Besides inflammation of the mucous membrane of the larynx, &c., at its free surface, the connecting cellular tissue is probably the occasional seat of all the inflammations that have been mentioned. Thus the loose cellular tissue around the glottis is often seen red, injected, and thickened, and likewise the seat of extensive serous effusion, greatly contributing to the death of the patient. Bouillaud and Andral have also both seen abscesses of the submucous cellular tissue of the larynx. Abscesses have also formed in the superior portion of the œsophagus which have burst into the larynx.

The mucous membrane of the larynx, in addition to being the seat of inflammation, is sometimes affected with *Ramollissement*. We are astonished to find, says Andral, on examining individuals (*Anat. Pathol.* tome ii. p. 473) who have been a long time hoarse, no other lesion of the larynx than a partial softening of the mucous membrane, especially of the chordæ vocales, and of the base of the ventricles, nearly denuding perhaps the resplendent fibres of the thyro-arytenoidean ligaments, which are now merely covered with a red or whitish pulp.

In a very few instances polypous growths take place from the mucous membrane of the larynx, as from that of the pharynx or nose, and which gradually increasing, at length destroy the little patient.

Besides inflammation or other disease of the mucous membrane of the larynx taking place, the parts beneath are often the seat of many different affections. Thus the muscular tissue of the larynx, arranged so beautifully in distinct fascia, and fulfilling such important functions, is sometimes found atrophied, hypertrophied, softened, or more or less completely destroyed, and causing marked alterations of the voice. It is seldom that the os hyoides is found diseased; but in a case that died some years ago in St. Bartholomew's Hospital, with symptoms of most severe laryngitis, that bone was found necrosed and separated at its apex, so that the soft parts had fallen in, and the patient died suffocated.

The cartilages of these parts also are often the seat of disease. Thus the cartilage of the epiglottis often loses its normal form in consequence of inflammatory contraction of the mucous membrane covering it. This cartilage also is sometimes from the same cause much less moveable than in health, and in some very few instances it has been seen ossified. In other cases it has been removed more or less completely by ulceration, commencing either within itself, or else extending from the mucous membrane. The other cartilages of the larynx, as the thyroid and cricoid, are often similarly diseased, and may be ulcerated, perforated, or necrosed, and in some cases suppuration has taken place at the articulation of the cartilages, and the ligaments been destroyed.

Ossification of the thyroid and of the cricoid cartilages is a normal phenomenon in old persons, but it may take place prematurely, and then it is morbid. No case, however, is known of ossification of the arytenoid cartilages.

Symptoms.—Croup may be preceded by sore throat,

Elementary Principles of Medicine.

by catarrhal symptoms, or by a short dry cough, or it may occur *per se*, and without the general health being sensibly impaired. In either case the attack commonly takes place during the night, the sleep of the child, which was perhaps more or less agitated, being interrupted by fits of hoarse coughing. These become more frequent, the respiration more difficult, and marked by a peculiar wheezing, which has been described as varying from the sound of an inspiration forcibly made with a piece of muslin before the mouth, or to air passing through a brazen tube. The little patient also feels a sense of constriction about the throat, which she marks by carrying her hand often to it, and grasping the larynx. After the paroxysm has lasted some hours, there is an interval of ease, which perhaps lasts for some hours, till the excitability of the parts is again accumulated.

By the end of the second or third day, sometimes sooner, the tongue becomes white, the heat of the body increased, the pulse frequent, the countenance livid and distressed. From this point the disease now rapidly advances, the croupy sound attains its height, and Dr. Horne describes it as " vox instar cantus galli;" others have compared it to the noise which a fowl makes when caught in the hand; while the child often puts its fingers into its mouth, as if to pull away something which obstructed the passage.

As the disease draws towards a close the paroxysms become more frequent, the cough more severe, the pulse more rapid, suffocation more imminent, and the extremities cold and livid. The final close of the disease is often by convulsions, sometimes almost tetanic; and Dr. Ferriar once was present when the struggle was so violent that after death the corpse in a great measure rested on the occiput and on the heels.

It is seldom that children expectorate; but in happier cases than the above, mucus, tinged perhaps with blood, is coughed up, and later perchance the false membrane is detached and thrown up, and the patient recovers.

The croup which has been described is of the acutest kind, but in many cases its course is much more chronic, the symptoms generally milder, and the intervals of ease longer and more complete; and during which the breath is free, the child cheerful, and the appetite good. In the course of a few days, however, a violent paroxysm seizes the child, and destroys him with every appearance of one strangled.

The internal fauces, as the tonsils, uvula, velum pendulum palati, are sometimes seen inflamed and ulcerated, while in other cases the fauces are healthy.

Several cases are on record of croup having terminated in 24 hours; more frequently, however, the child lives to the third or fourth day, and in chronic cases much longer.

According to Barth, on the stethescope being applied to the larynx, we hear a sort of " tremblotement," as if a moveable membrane was agitated by the air; and he considers this phenomenon as an unerring evidence of the existence of a false membrane in the larynx.

Laryngitis in the adult is marked by the same difficulty of breathing, the same lividity of countenance, the same constriction of the throat, by the same paroxysmal attack, and by the same exemption from any severe constitutional affection. The voice, however, instead of being sharp and shrill, is generally deep and hoarse, although sometimes altogether lost; differences depending perhaps on the greater size of the glottis, and on the fact of the parts being the seat of ulceration, rather than of the effusion of lymph. At length the patient is cut off in one of the paroxysms. The duration of this disease, when acute, is short. The celebrated Dr. Pitcairn died on the fourth day from the first attack, and Sir John Hay, physician to the forces, died within the same period. More commonly, perhaps, the disease passes into a chronic state, when the patient may survive many weeks, or even months.

Polypus of the larynx is a rare disease. In one case a child between three and four years old had laboured for more than two years under attacks of croupy breathing, but without greatly suffering in her general health. At length her voice became permanently stridulous and shrill, with severe paroxysms of difficult breathing; in one of these she died, when a small polypus about half an inch in length, and adhering by a pedicle, was found growing from the posterior portion of the larynx.

Ossification of the cartilages alters the timbre of the voice and deepens its tones, but does not produce any general or local inconvenience.

Diagnosis.—Inflammatory croup in the child is to be distinguished from false croup by the latter being sudden in its attack, and by the voice being extremely hoarse instead of shrill, the glottis not being obstructed by any adventitious membrane. In the adult we must distinguish inflammatory laryngitis from sympathetic laryngitis, and from that caused by the pressure of an aneurismal or other tumor, as enlarged glandulæ concatinatæ.

Prognosis.—The danger of croup is to be determined from the violence of the local symptoms and the frequency of the paroxysms, rather than from the constitutional symptoms. Children, however, seized with croup recover in a very small proportion.

The adult also, after ulceration has taken place, seldom recovers; but his case is not so hopeless as that of the child.

Treatment.—When the croup in children commences in the larynx its course is so rapid and so fatal that the measures for its suppression must be early and energetic. Bleeding, and especially local bleeding, should be employed, and in most cases to a considerable extent, and two to twelve leeches, according to the age of the patient, should be applied over the larynx; and after these have fallen off the bleeding should be encouraged by the application of a linseed poultice to the throat. This first bleeding often gives great relief, and sometimes stops the disease; but if not, the leeches, after a few hours, may be repeated. As soon as some relief is obtained a blister should be applied, and after that is removed the part should be dressed with strong mercurial ointment. Besides this local treatment it is usual to give mercury by the mouth; some practitioners even give it as largely as one to two grains every hour, and Brettoneau says he has given as much as three scruples in twenty-four hours. This ultra active treatment, however, looking to the great mortality attending croup, can seldom have been successful; and it may be doubtful whether in many instances it has not accelerated the fatal termination.

In addition to bleeding, blistering, and mercury, many practitioners prescribe emetics; first, because their depressing effects and the large evacuations they produce lower the vital power and favour the resolution of the inflammation; and again, because the effort of vomit-

ing may be the means of detaching and of expelling the false membrane, should it have formed.

Bleeding, blistering, and mercury, although the rule of treatment in idiopathic infantine croup, are, for the most part, entirely inefficient in those cases in which the affection begins in the fauces, as in the case of many epidemics, and especially after scarlatina. In these cases the best treatment, if the false membrane be not already formed, is to treat it as a case of scarlet fever, and to relieve the throat by the application of a few leeches, and then to support the little patient with a moderate quantity of wine diluted with water. Several cases recently treated in this manner all recovered, while two that were extensively bled died. If the false membrane has formed, perhaps an emetic affords the only chance of relieving the patient.

In the adult the pathological phenomena are somewhat different from those of childhood, the mucous membrane of the larynx being for the most part ulcerated, and the cartilages often diseased. Large bleedings, consequently, as they have little tendency to heal the ulcerated part, or to remedy the affection of the cartilages, have little or no beneficial influence over the disease. Dr. Pitcairn was once copiously bled, and Sir John Hayes was bled from 30 to 40 ounces, but they both died. Local bleeding may be employed to relieve the fulness of the throat, but beyond this bleeding is of little value. Mercury, however, appears a powerful resource in these cases; and mercury, introduced either internally or by inunction, so as to affect the mouth, uniformly gives relief as soon as the constitutional affection is established. Unhappily, however, the amelioration is transitory, for almost as soon as the mouth is healed the symptoms return, and the patient again lies in imminent danger. Another salivation produces another cessation, but equally temporary, and the patient ultimately falls. It may be problematical whether we possess any more powerful remedy for this affection; but in two cases in which the disease was very marked, so much so that in one there was a fistulous opening externally, the oxyde of platina, exhibited in doses of two grains three times a day, cured the patients, after mercury and many other remedies had failed. A third case has also been treated in the same manner with equal success very recently. This substance acts as an emetic in doses of grs. iij. to grs. v. Platina, however, is quite useless when the laryngitis is a secondary disease, and caused by phthisis or syphilis; it is also useless when the laryngitis depends either on a diseased state of the cartilages, or of the os hyoides.

The medical treatment of laryngitis, both in the child and in the adult, is so frequently unsuccessful that tracheotomy has often been had recourse to as the means of prolonging life, and consequently as affording an additional chance of the patient's recovery. Guersent has performed this operation repeatedly at the Hôpital des Enfans, but almost always without success; on the contrary, Trousseau states he has saved one-third of his patients. Perhaps the experience of the profession is equally discordant on this point; for those who operate early, and perhaps often most unnecessarily, contend they save some portion of their patients, while those who wait till a case is made out before they resort to this experiment for the most part lose all their patients. The cause of death after the operation is often extremely perplexing, for the patient, whether a child or an adult, often revives, breathes freely, and the local inflammation from the use of the knife is generally trifling, and yet the patient dies. Some physicians attribute this result to congestion and disease of the lung itself; but as the patient often lives for three or four days tranquil, and almost without cough, this hypothesis does not appear satisfactory. The fatal result, therefore, seems rather to depend on a cause acting generally on the system, and which destroys the patient. It must be admitted, however, that in a very few instances, when the croup perhaps is the result of a local cause, that the patient, whether a child or an adult, does recover. Dr. James Johnson lately mentioned, at the Medical and Chirurgical Society, an instance of a man who had lived 27 years breathing through a canula inserted low in the trachea. It should be remembered that in the adult the cricoid cartilage may possibly be diseased, and consequently it is desirable the incision for tracheotomy should be as low down as possible.

Of Tracheitis.

The remote and predisposing causes of this affection are nearly similar to what have been mentioned as producing laryngitis. As to its pathology, the mucous membrane of the trachea is liable to the diffuse, the serous, and the suppurative inflammation, and all these occur frequently in the course of a common cold, and without any marked or dangerous symptom. In a very small number of cases lymph is found effused on the free surface, but most likely this form of disease is always an extension of laryngitis or of bronchitis. Ulceration of the trachea is extremely infrequent, except in phthisis, when the ulcers occupy, by a species of election, the posterior portion of this canal. When they are primary they sometimes are seen in other parts of the trachea.

The cartilages of the trachea are rarely the seat of disease; but they also are liable to be inflamed, perhaps ulcerated, and certainly necrosed. A case of this kind occurred some years ago in St. Thomas's Hospital: the patient, a stout young woman about 20 years of age, laboured under much hoarseness and difficulty of breathing, but her general health was good. She died suddenly in the night, and as was supposed from spasm of the glottis. On examining her, a small ulcer was found in the mucous membrane of the trachea, and beneath it the cartilage was necrosed and broken. Andral once met with a case of abscess of the thyroid gland, with complete destruction of the cartilages of the trachea, and the pus of the abscess had made its way so as to have raised up the tracheal mucous membrane. Portal also gives a case in which hydatids of the thyroid gland perforated the trachea, and suddenly destroyed the patient by asphyxia. A larynx was lately shown at the Medical and Chirurgical Society of which the three upper cartilages appeared to have been absorbed, and that without any apparent cause. The patient died at length asphyxiated. The cartilaginous rings of the trachea are occasionally seen ossified, but even this is a very rare circumstance.

Of Pneumonitis.

Pneumonitis is an inflammation of one or more tissues of the lungs. Thus the bronchial membrane may be inflamed, causing *bronchitis;* or the substance of the lung may be inflamed, causing *pneumonia;* or the pleura may be inflamed, causing *pleuritis;* and two or

more of these inflammations may exist at the same time. The number of persons reported to have died of these complaints in England and Wales, in 1839, amounts to 20,402; or from bronchitis, 1663; from pneumonia, 18,151; and from pleurisy, 588; thus causing the death of about one person in sixteen.

The class of disease now about to be treated of was well known to the ancients, but we owe much to Avenbrugger and Laënnec for having studied the physical properties of the chest, and demonstrated the great changes the natural sounds heard by auscultation or produced by percussion undergo when the different tissues of the lungs are affected, and which have enabled the moderns to give a precision to their diagnosis of disorders of the chest entirely unknown to those who have preceded them.

Remote Causes.—Inflammatory affections of the lungs are caused by many morbid poisons, as the poison of typhus fever, of the measles, of small-pox, of influenza, and also of the paludal poison. It is probably owing to the action of the last poison that, although as a general principle diseases of the chest diminish in frequency as we approach the equator, yet that in the West Indies the inflammatory pulmonary affections greatly exceed those of this country. In the more northern climates these affections are intimately connected with atmospheric vicissitudes, as cold and wet; at least we find them prevailing most in those months in which the temperature is lowest. Thus, in the winter quarter, 3891 persons fell from these causes; in the spring quarter, 2823; in the summer quarter, only 2057; and again in the autumnal quarter the numbers amounted to 3799. Mechanical injuries, as blows, especially if a rib be fractured, are also occasional causes of pneumonitis. As a secondary affection, pneumonitis may be caused by phthisis, by the presence of hydatids, or by the pressure of an aneurismal, cancerous, or other tumor.

Predisposing Causes.—Young children are often attacked with pneumonitis; adult age is still more liable to that disease, that period of life being most exposed to all the great moral and physical causes of disease, as well as to the action of many morbid poisons. Old age is most liable to that form termed bronchitis; and this arises from the decline of the powers of life, which often first shows itself by disease of the organs supplied by the eighth pair, as the heart, the lungs, or the stomach. It appears that men are something more exposed to all these affections than women. Thus there died in

	1838		1839	
	Men.	Women.	Men.	Women.
Of Bronchitis .	1,193	874	916	747
Pleurisy .	329	253	342	246
Pneumonia .	9,887	8,112	10,000	8,157

The effects of those many causes which deteriorate the health of the inhabitants of towns are extremely marked in the production of pneumonitis, for, out of a million of persons living in towns, 2028 died; while out of a similar number of agriculturists, only 905 fell in 1839. Having thus spoken of the general and predisposing causes of pneumonitis, it will now be necessary to speak of the pathology of the different tissues composing the lung, and first of *bronchitis*.

Pathology of Bronchitis.—The mucous membrane lining the bronchial tubes is liable to the diffuse, the serous, the adhesive, the suppurative, and to the ulcerative inflammation, and these may be either acute or chronic.

In red diffuse bronchitis we find the inflamed portions of the mucous membrane of a deep venous red, and this redness may be general or partial, and when partial it may be in spots or streaks, determined perhaps by the cartilages. This inflammation, when at its height, is probably void of secretion, and the membrane consequently dry, and giving rise to the "catarrhe sec" of Laënnec. This may at first terminate by resolution, or it may pass into the serous inflammation, when the mucus first secreted is thin, watery, and even frothy like saliva, but which subsequently becomes thicker and more consistent; and again it may take on the suppurative inflammation and pus be effused. In a very few cases lymph is thrown out, forming a false membrane, and in a still smaller number (except in phthisis) ulceration of the bronchial membrane occurs, and this may take place from within outwards, or from without inwards, but the latter is by far the most common.

Most authors affirm that the bronchial membrane, when inflamed, is thickened, and more particularly at the points of division, and that the various râles depend on the degree of thickening of this membrane, slight alterations of diameter producing great alteration of sound. Andral even says that the mucous membrane of the smaller bronchi may be so thickened as to cause a complete obstruction. This thickened state of parts, however, is very difficult to demonstrate, and many intelligent pathologists have never witnessed it, and consequently attribute the different râles so often heard in bronchitis to spasmodic contraction of the circular fibres.

The bronchitis may affect one lung, or both lungs, or a part of a lung, and the upper lobes are more commonly affected than the lower ones. The larger bronchi are also supposed to be more commonly inflamed than the smaller ones.

Although it is by no means uncommon to find red or chromatous inflammations of the bronchial membrane, yet it is equally common to find various forms of achromatous inflammation. Thus nothing is more usual than to find the mucous membrane beneath a purulent secretion either natural in colour or else paler than in health, so that the most profound pathologist is unable to distinguish the morbid from the healthy state.

The cartilages of the bronchi are occasionally found dilated, forming a small bronchial pouch. They are also sometimes hypertrophied, and, instead of points, form imperfect rings, as in the larger bronchi or in the trachea. The cartilages also, in some rare instances, have been found ossified; and Andral gives a case of an old man dead at Bicêtre, whose lung presented the ramified appearance of a piece of hollowed coral, or of the branches of a tree; he considered these to be the last ramifications of the bronchi in a state of ossification. The cartilages of the bronchi, when the lung has been long collapsed, appear to be absorbed, hardly a trace of them being discoverable.

Hydatids have occasionally been coughed up from the lung, perhaps formed in the bronchial membrane in the same manner as in the mucous cavity of the uterus or bladder. Some very rare instances are also given of polypous growths from the bronchial membrane.

Pathology of Pneumonia.—The substance of the lungs is liable to the diffuse, the serous, the adhesive, the purulent, the ulcerative, and to the gangrenous inflammations; and these inflammations are all *acute*,

chronic inflammation of the substance of the lungs, according to many writers, being unknown.

The characters of diffuse inflammation of the substance of the lungs are the lung being more loaded with dark venous blood than usual, and its texture being more easily broken down than in health; air, however, still penetrates the bronchial cells, and consequently the lung still crepitates, swims in water, and, if washed, the colour is restored. This inflammation may terminate by resolution, or it may pass into some higher degree of inflammation.

When serous inflammation succeeds, the lung is in the same gorged state, but in addition it is loaded with serum, so that on cutting into it a watery fluid mixed with blood streams from it as from a sponge. The lung now no longer crepitates, is enlarged, often takes the impression of the ribs, and does not collapse when the chest is opened.

At a higher degree of inflammation lymph is thrown out, and the lung is now technically said to be in a state of red hepatization, or, as Andral has termed it, red softening. This state has many degrees. In some instances the lymph effused is very large in quantity, mixed with blood, and can be readily separated, or, as it were, *shelled* out of the lung, and in this loose state it is not organized. In the other extreme of this form of inflammation the lymph effused has become organized, and forms an integral part of the lung, which now becomes so solid that, if cut, it represents with much accuracy a portion of the liver or spleen. In this state it contains at the diseased part little or no air, does not crepitate, and sinks in water; it cannot be injected, is of a deep venous colour, while its texture is easily broken down and penetrated by the finger. The lung also is enlarged, and does not collapse when the chest is opened.

A still more severe form of pneumonia is suppurative inflammation, and the pus effused may be either infiltrated or contained in an abscess. Infiltration is by far the most common; and although this form of disease may occur *per se*, yet in the belief of most authors it more generally follows red hepatization. In this latter case the pulmonary tissue, red, dense, compact, and impermeable to air, passes to a grey colour, and hence it is termed grey hepatization. The structure in other respects of either form of hepatization appears to be the same; for if we examine them with a microscope, we find the same granulations, only they are white or grey instead of red. There are instances, however, in which these are wanting, and we observe only a grey smooth surface.

In the grey, as in the red hepatization, the pulmonary tissue is easily torn, and the quantity of pus infiltrated is sometimes so great that, on cutting into the lung, that fluid readily flows from it; at other times the pus will not flow on a simple incision, but exudes by compression.

Although pus is more commonly diffused through the pulmonary parenchyma, yet sometimes it is collected into an abscess. In the infancy of pathology physicians regarded phlegmonous abscess of the lung as a common and ordinary occurrence, but it is extremely rare; and Laënnec, when he published the first edition of his work, had only met with six cases, notwithstanding all his extensive research; and in the practice of every other physician phlegmonous abscess of the lung is equally uncommon. Abscess of the lung, although termed phlegmonous, to distinguish it from tubercular abscess, generally exists without any great intensity of inflammation or other considerable alteration of its tissue.

Pneumonia may also terminate by gangrene, which is also as rare a termination as by abscess. It occasionally arises from excess of inflammation, but more commonly the inflammation which precedes this state is of little intensity, so that it rather approaches to anthrax, or pestilential bubo, and the inflammation around the gangrened portion appears to be the effect rather than the cause of the mortification. The gangrened portion may or may not be circumscribed, and is found in the different states of gangrenous eschar, of deliquescence, of sphacelus, and lastly of simple excavation, the gangrened portion having been detached and escaped.

The frequency with which these different forms of inflammation occur is not yet estimated, but is probably in the inverse order of their intensity, the diffuse inflammation being the most frequent, then the serous, the adhesive, the purulent, and lastly the gangrenous.

Pneumonia may be either single or double,—that is, it may attack one or both lungs at the same time. Thus, out of 210 reported cases, 121 were on the right side, 58 left side, and 25 double, while the seats of 6 were unknown. Of the part of the lung attacked, out of 80 cases of pneumonia 47 consisted of inflammation of the inferior lobe, 30 of the superior lobe, while 11 times the whole lung was inflamed.

Bronchitis may take place without pneumonia, but in many cases pneumonia follows as a consequence. Pneumonia also may take place without bronchitis, but in general bronchitis accompanies it. Pneumonia also may take place without pleuritis, but it generally happens that the pleura is more or less affected.

Much speculation has been entertained with respect to the more particular seat of pneumonia, some contending the inflammation affects the cellular tissue of the lung, and others the air-cells, others both. It is quite certain, however, that the minute bronchial tubes are not affected in slight pneumonia, for in such cases their divided extremities stand out in the midst of the inflamed part like so many white points. When the lung is more acutely inflamed the bronchial tubes are red, and evidently greatly inflamed. It has been stated that chronic pneumonia is supposed by many writers not to exist.

Besides being subject to inflammation, the lung may be hypertrophied. Thus Laënnec observed a great number of cases in which one lung being no longer able to fulfil its functions from effusion of air or fluid into the cavity of the chest, that the healthy lung acquired a volume manifestly greater than normal, its tissue being more dense and compact, so that it did not collapse on opening the chest, and more resembled the lung of a child or of a horse. This hypertrophy may take place in no very long time. Laënnec, for example, found this alteration in a man who, six months before, had suffered from a pleuritic attack, in consequence of which the lung on the diseased side became atrophied, and the chest deformed. This alteration is the result of the law, if one of a double organ becomes atrophied, or incapable of performing its functions, the other becomes the seat of greater nutrition and more active function.

The lung may likewise be atrophied, a condition common to old age, when it becomes of less volume,

contains less blood, and is of a remarkable lightness. In other eases the atrophy is the result of disease, as after collapse from empyema, when the lung is often little larger than the fist, without any trace either of bronchi, of eells, or of eartilages.

The sole entozoaires which have as yet been met with in the substance of the lung are acephalocysts; and Andral has seen one entire lobe transformed into one vast hydatid cyst. In another ease he found a colleetion of hydatids in the interior of a considerably dilated pulmonary vein. A recent instance of hydatids of the lung is also given in the *Bulletin de l'Académie Royale.* These parasites, however, though common in animals, are happily rare in man. The lung has also been found the seat of steatoma. Thus Sir Astley Cooper stated, that he found the lungs of his late Majesty, George the Fourth, loaded with fat. The substanee of the lungs is also oceasionally the seat of ossific deposits, and portions of evidently ossified eellular tissue have often been expeetorated.

Pathology of Pleuritis.—The pleura is the membrane covering the lungs, as well as lining the eavity of the chest, and is liable to all the inflammations ineident to other serous membranes, or to the diffuse, the serous, the adhesive, the suppurative, the ulcerative, and to the gangrenous, and these may be either aeute or ehronic.

The diffuse inflammation begins in the sub-pleural tissue, whose vessels enlarge and admit red blood, and shortly afterwards the red blood penetrates the web of the pleura itself. At first a number of red dots or punctures are seen, which at length are so multiplied as to beeome eonfluent and form large patches, which spread till perhaps the whole of the pleura pulmonalis and costalis is one eontinued inflammation. The membrane is in all cases of a bright red or arterial colour, slightly thiekened from interstitial deposit, and easily detached from the now increased lacerability of the subcellular tissue.

If the diffuse inflammation be of any intensity, the secretion from its surface is in general suspended, and the membrane is dry. In this state the inflammation may terminate by resolution, or serum may be poured out, causing *serous inflammation.*

The quantity of serum effused is very various, in some cases hardly exceeding a very few ounees, while in other eases it amounts to many pints, filling that cavity of the chest which is the seat of inflammation. Laënnee is of opinion that the time of effusion after the commeneement of the inflammation is often very short, as he has detected ægophony and absence of respiration, as well as of thoracic resonanee, an hour after the patient has first felt pain in the side, or "le point de côté." If the effusion be considerable the lung becomes collapsed, contains no air, and therefore no longer erepitates; the vessels are devoid of blood, while the bronchi, even to the large trunks, are evidently contracted; still, if this lung be inflated it enlarges more or less perfectly. Again, should the pleuritic effusion be less in quantity, some fluid appears spread all over the lung; but the greater quantity is always collected at the lowest portions of the chest.

Accompanying either of the previous forms, or else existing *per se*, lymph may be thrown out, and adhesive inflammation be set up. In many eases the lymph thrown out is loose and watery, sometimes only rendering the serum turbid or floeculent; but in other eases it is more solid, and adheres with great tenaeity to the opposite membrane, and beeomes organized at both surfaees. The organization of these membranes is rapid, and is often effeeted by the end of 24 to 48 hours. If the patient falls shortly after an attaek of acute inflammation, these adhesions are found soft, easily lacerable and extensible, and in this state are perhaps sometimes absorbed. If, however, he survive a longer period, the adhesions are often of great tenacity, are indurated, and with difficulty separated from their attachments. The extent of membrane affected with adhesions is very varied, sometimes limited to a small portion, and sometimes extending over the whole eavity, but their most common seat is generally the anterior lobes, or the portion from the mammæ to the axillæ.

The pleuritic inflammation sometimes terminates in suppuration; and should the pus be in such quantity as to aeeumulate in the cavity of the chest, the disease is termed *empyema.* Empyema may be true or false: it is said to be true when the pus is seereted by the pleura, and false when it results from the bursting of an abseess of the lung into the cavity of the ehest. The quality of the pus in true empyema varies from a genuine laudable pus to a sero-purulent fluid. In quantity also it varies from a few ounees to many quarts, filling the entire cavity of the chest. Under these latter eircumstances the side of the ehest is dilated, and the intereostal spaces widely separated and bulging.

Effusion of pus may take plaee into either cavity of the chest, but the left perhaps is the most common; at least three cases have been observed in St. Thomas's to one on the right. The phenomena aeeompanying empyema of the left side are remarkable; for, besides the lung being found collapsed, not so big as the fist, and often without a traee of bronchi or of bronehial cartilage, the heart is sometimes seen transposed as far over on the left side as it usually is on the right. Under these extraordinary eireumstances, if we examine the chests of these patients after death, if paraeentesis has not been performed, the heart is found to return to its natural position in proportion as the pus flows, showing that it is rarely fixed in its new situation by adhesions. In other cases, however, in which paraeentesis has been performed, and the pus has been drawn off, the heart is found in its place, while the lung, less eompletely eollapsed, is bound down to the upper and lower portion of the ehest by long and multiplied adhesions, which entangle large quantities of pus, and are perhaps the eause of the ultimate fall of the patient.

Sueh are the red or ehromatous inflammations of the pleura, but it is also the seat of many aehromatous inflammations. Thus large quantities of pus, extensive adhesions, or a great exeess of serum has been often found in the ehest, and yet the patient has not suffered any pain during life, neither ean a red vessel be traced after death. The adhesions which thus form often give rise to many singular phenomena: their tenaeity is notorious, the lung constantly tearing without their yielding, while they are sometimes so extensive as to bind that organ throughout all its extent to the ribs, and limit its play to the mere rising and falling of the ehest. They also, like all newly-formed abnormal parts, readily run into disease; and hence we often find them the seat of serous or purulent effusions, forming a partial hydrothorax or a partial empyema. The pleura also sometimes beeomes the seat of ossific deposits. Laënnee has seen it eonverted into a fibro-eartilage, Dr. Baillie into a plate of bone; and in the Museum of St. Thomas's

Hospital there is a specimen of a bony pleura, occupying almost half the chest, and fixing the ribs, so that it is remarkable how life could have been continued with so extensive a disease. Hydatids have also occasionally been found in the cavity of the chest.

Symptoms of Pneumonitis.—Pneumonitis is determined to exist by two classes of phenomena, or by the general and physiological symptoms, and also by certain mechanical phenomena arising out of the physical structure of the lungs and of the chest. It will be better first to describe the general and other symptoms, and then the phenomena arising from percussion and auscultation.

General Symptoms of Bronchitis. — Bronchitis, of whatever kind, is often preceded with fever, more commonly by symptoms of a common cold; but it also often commences without any previous illness; in whichever way, however, it begins, the hoarse altered voice, the cough, and expectoration, are too palpable to allow us to mistake the nature and existence of the disease. In a very few instances of diffuse inflammation the cough is dry and without expectoration, but far more generally it is accompanied by sputa; the sputa vary greatly according to the different degrees of inflammation, or according as that inflammation is acute or chronic, sthenic or asthenic. In acute cases it is at first a thin mucus streaked with blood, then more opaque, and lastly purulent; in more chronic cases it may be merely a muciform saliva, or a gelatiniform mass, or it may be like the unboiled white of egg, so tenacious that it may be poured from one vessel into another without separating. In other instances it is puriform, varying from a laudable pus to a red or green æruginous putrilage. When purulent it is usually formed into sputa, but in a few cases it is thrown up in large quantities unmixed, as from an abscess. The quantity of matter expectorated also varies greatly; sometimes only a few sputa in the morning, at others half a pint or a pint in the 24 hours, while other patients actually die suffocated from the immense quantity which is suddenly poured out.

The cough is seldom accompanied by any pain in the inflamed membrane, and has many degrees of violence. It may occur in paroxysms, and the sputa be discharged after a violent effort, at night, or in the morning, or at other definite intervals. Again, it may be incessant, harassing the patient at every instant, causing a sense of soreness or constriction of the chest, and sometimes severe pain at the ensiform cartilage, in consequence of the mechanical exertion of coughing.

With respect to the effects of the cough on the constitution, the patient, supposing the disease to be unconnected with any morbid poison or organic affection of the substance of the lung, suffers little in his general health, and would be well if he could get rid of "the cough." In other cases he loses flesh, throwing up every meal from the violence of the cough, while in others he sinks into a state of marasmus simulating phthisis. His pulse is generally natural, although in some cases it is frequent; his bowels also are regular. In bad cases, however, the patient's nights are broken, but he sleeps towards morning while in slighter cases he sleeps through the night but is disturbed in the morning.

The duration of this affection is very various: sometimes it terminates in a few hours, sometimes in a few days, ceasing with the cold that produced it. In other cases its duration is long, and it is with difficulty recovered from, and thus often lays the foundation of phthisis or other formidable disease, which ultimately destroys the patient. In old persons it generally returns every winter, or lasts, with intermissions, the whole year.

General Symptoms of Pneumonia.—Pneumonia is generally preceded by some antecedent fever, or by shivering more or less violent, and often by bronchitis. In a few cases, however, it is the primary affection.

The disease being set up, the patient is restless and uneasy; his respiration difficult and hurried, or from 30 to 50 in a minute; his cough frequent, and his expectoration streaked with blood; but notwithstanding this symptom he seldom, unless the pleura is affected, suffers pain; and hence the adage that in pneumonia there is "plusquam periculi quam doloris." His pulse is full and frequent, or from 100 to 120; his countenance livid; his nostrils dilated; his tongue purple, and coated with a white or yellow mucus, while he lies on his back supported by pillows. If the patient recovers, these symptoms are gradually mitigated; but should he fall his tongue becomes brown and typhoid, his pulse more rapid, profuse sweats break out all over his body, and at length his mind wanders, and he dies comatose, or half asphyxiated. There are many instances, however, where the course is widely different, and in which the patient, though evidently distressed by impeded respiration, has yet moments of cheerfulness; gets up; walks about the ward; but dies during the day, seized with a severe paroxysm of dyspnœa or of coughing.

Such are the general symptoms of pneumonia; and, except by their different degrees of intensity, it is difficult to distinguish the different forms of inflammation from each other without the application of the stethescope. The general symptoms of serous pneumonia, however, are the most marked; the uneasiness being greater, the respiration louder and more difficult; the countenance more livid and swollen, the cough more harassing, the expectoration more abundant, and the attempt to lie down impossible. A gangrenous state of the lung is determined by the intolerable fœtor of the breath.

The duration of pneumonia is very various. Laënnec conceives the diffuse inflammation to last seven or eight days—Andral, red hepatization to last 15 to 20 days; while grey hepatization, when an original disease, is supposed to destroy the patient in 24 or 36 hours from the first symptom of attack. More generally, however, taking all its forms, pneumonia terminates between the seventh and the twentieth day.

General Symptoms of Pleuritis.—Pleurisy, like other inflammations of the lungs, may be acute or chronic. The acute form of this disease may be preceded by fever, but often no such antecedent is present. Its local symptoms, however, in most cases, are strongly marked; the patient suffering with severe continued *pain* in the affected side, which is greatly exasperated by coughing, or other forced inspiration, so that the chest can only be half filled with air. The seat of the pain, however extensive the inflammation, is generally limited to one point, termed the "point de côté," and this point is generally about the centre of the mamma, or just below that part. The tongue is commonly white, but the pulse varies perhaps according to the form of the inflammation and its intensity; or, if the disease be limited to an

Elementary Principles of Medicine.

effusion of lymph or serum, the pulse is seldom more than 90 to 110; and either form of pleuritis is also generally accompanied by a short troublesome cough, and some expectoration. The patient likewise is for the most part restless, and lies on the affected side. After effusion of serum has taken place, the pain is much mitigated; but if it be in any quantity the lung is compressed, which increases the general uneasiness, as well as the oppression of the breathing, and the patient, instead of lying on his side, now lies on his back, or else sits propped up in bed. If he recovers, the fluid effused is absorbed, with greater or less rapidity, and his amendment is proportionably retarded or accelerated. In fatal cases, although the lung may for a time become accustomed to the altered state of things in the chest, yet fresh effusions occur, and shortly terminate the life of the patient.

Again, if the inflammation is about to terminate by effusion of pus, the pulse is extremely small and frequent, or from 120 to 150, while the restlessness and anxiety of the patient is greatly increased. It is strange, however, that there are cases of empyema, in which the patient suffers little pain, or any more marked symptom than usually awaits the last stages of phthisis. In some instances he is for a time even capable of walking about the ward. Supposing, however, the empyema to have formed, any acute pain the patient may have suffered subsides, but the anxiety of the patient is increased, and his state of collapse shows his imminent danger. On the contrary, if the constitution be less affected, the symptoms vary according to the side of the chest which is the seat of the empyema. If it be on the left side, for example, the heart is often transposed, and felt beating as far over on the right side as it usually does on the left, and the pulse is small and frequent. If we now bare the chest of the patient, we find the affected side enlarged, sometimes œdematous, with projecting intercostal spaces. As the lung is now greatly compressed, no respiratory action is seen on that side, which is entirely at rest. If an operation be now performed, the heart is restored to its place as the pus flows; but as the lung for the most part only imperfectly expands, the affected side, even in the most favourable cases, contracts, and the spinal column, pressed upon by an unequal weight, acquires a lateral curvature; the shoulder sinks, and the patient is greatly and permanently deformed.

The duration of acute pleurisy is very various, sometimes terminating in a few hours, sometimes in a week or ten days, while Laënnec has met with cases in which many months have elapsed before the pleuritic effusion has been absorbed, and the patient restored to health.

Such is a short account of the physiological symptoms which mark pneumonitis; and it will now be necessary to add those physical symptoms which render the seat of the disease, as well as its nature, more definite and precise.

Physical Symptoms of Pneumonitis.—On striking the chest of a person in health, it returns, like a half-filled cask, a certain hollow sound, demonstrating it to be partly filled with air. Also, if we place the ear to the chest, we hear certain sounds on inspiration and on expiration, which are termed the respiratory bruit or sound. In disease these natural sounds are altered, the sound on percussion being rendered duller or clearer than natural, while the bronchial respiration undergoes still more remarkable alterations; and these modifications frequently enable us to determine the nature and seat of the disease.

Physical Symptoms of Bronchitis.—The natural and healthy respiratory bruit of an adult has been compared to the sweet sleep of a healthy child; but in bronchitis this sound is changed, and varies in different cases, from a tolerably sharp sound, which, when multiplied from a number of bronchi being similarly diseased, resembles the chirping of a nest of young birds, to the bass note of the violoncello, and consequently embraces a musical scale of considerable compass; the principal and more marked division of which, Laënnec has termed "râle sonore ou renflement," "râle siffilant sec ou sifflement, râle tourterelle, and râle musicale." The cause of the higher notes has been supposed to be owing to a thickening of the mucous membrane at the orifices of the various bronchial tubes, so that the natural embouchure is narrowed, and a musical wind instrument thus formed. To those who have observed in the dead body a swollen state of the bronchial membranc, this explanation may seem satisfactory; but to those who deny the existence of any such phenomenon, it seems more easy to explain this morbid sound by different degrees of contraction of the circular and longitudinal fibres of the bronchi, in the same manner as we observe contraction of the muscular fibres of the œsophagus, or of the small intestines, causing stricture. The general law, also, that the orifices of parts are more often diseased than their more central portions, explains why this contraction should take place principally at the orifices of the bronchi, and hence the shrill piping or chirping sounds so often heard.

Laënnec has left the grave sounds entirely unexplained; and these are caused probably by an opposite state of parts, or by a relaxation both of the circular as well as of the longitudinal fibres, so that the bronchial tube is more open, elongated, and inflexible; and hence its vibrations are consequently longer, and the note more grave.

Besides the alteration of tone in bronchitis, its quality is also often affected by the presence of liquid matters within the cavity of the bronchi, and hence we have it interrupted and modified by the air passing through bubbles of mucus; and as the size of these bubbles and their viscidity vary, so the sound varics; and hence a scale has been established by Laënnec, whose extremes are the "râle muqueux," and the râle tracheal; the former representing the bursting of small slightly viscid bubbles; the latter larger ones of greater tenacity, and like those formed in gurgling. Sometimes this mucus, instead of being fluid, hardens so as occasionally to adhere and play as a valve, giving rise to a clicking noise, which has been termed by Laënnec, "bruit de soupape." These are the various morbid sounds heard in bronchitis; and the danger of this disease is denoted by the quantity of fluid effused, and by the gravity of the sound. The sharp chirping sound, as it denotes contraction, and consequently power, is less to be feared than the graver and deeper notes caused by relaxation, and consequently *loss* of power, and which shows that the air circulates with great difficulty in the bronchial cells. There is also another râle, which perhaps should be mentioned in connexion with bronchitis, or the "râle crepitant à grosses bulles ou craquement," which Laënnec compares to the blowing of air into a dried bladder, and is the pathognomic sign of rupture of the air-cells, and

of penetration of air into the cellular tissue of the lung itself. In addition to the alteration of the tone in bronchitis, some indication may be drawn, according as the times of expiration are prolonged. In health the times of inspiration are much longer than those of expiration; but, in disease, these times are often equal, and, in some instances, that of expiration is longer than that of inspiration. This change is also a proof of severe bronchial inflammation.

Percussion generally returns a healthy sound in bronchitis. It may however happen, when the lung is acting irregularly, that a number of counter-currents may cause it to return a dull sound, like a glass of champagne while the wine is still effervescing.

The Physical Symptoms of Pneumonia vary in proportion to the intensity of the inflammation, and the consequences it produces. Diffuse inflammation is determined by a râle termed "crepitant." This bruit evidently takes place in the pulmonary tissue, and is compared by Laënnec to the crackling of salt thrown upon the fire, or to air blown into a dried bladder, or to the crepitation of the healthy lung when pressed between the fingers. The cause of this râle is variously interpreted, some pathologists attributing it to the dryness which sometimes accompanies diffuse inflammation, while others attribute it to bubbles of air breaking in a fluid of something of greater density than water, and secreted in the cells of the inflamed part; crepitation, however, is rarely distinctly heard.

If the pneumonia assumes the character of serous inflammation, it is quite singular how loud a mucous rattle is heard; it resembles a loud roaring rather than crepitation, and is supposed to be caused by bubbles of air breaking through a mass of slightly viscid fluid. This phenomenon is one of the most remarkable connected with disease of the lung. In both the preceding forms of inflammation the chest on percussion returns in every part a clear sound, the air still penetrating every part of the lung. If a dull sound is returned, it is on account of counter-currents.

Should the pneumonia proceed, and red or grey hepatization take place, the lung is solidified, and the bronchial tubes being either temporarily or permanently obliterated, no air penetrates the diseased portion, whence it follows that not only is the respiratory bruit lost, but also that the chest at this part will return a dull sound on percussion. These are the conclusions from theory; but it is seldom, unless the disease be very extensive, that these conditions can be satisfactorily established; for the noise of the surrounding bronchitis, and the supplemental bruit of other portions of the lung almost entirely mask the absence of respiration in the affected portion. Again, if the hepatization be central, the air in the more superficial portions of the lung often prevents a dull sound from being returned on percussion. In this difficulty, however, there is one symptom which greatly assists our diagnosis, or *bronchophony*. When the lung is hepatized or solidified, it has necessarily become a better conductor of sound, so that the voice, instead of being destroyed in the chest, as in the healthy lung, is now conducted downwards. In this altered state of parts, if the stethescope is applied to the chest, and the patient directed to talk, his voice is distinctly heard in the chest, and at the end of the stethescope, but without passing through it. This phenomenon is termed bronchophony.

Pneumonia, it has been stated, sometimes, though rarely, terminates in abscess. The physical symptoms previously to the bursting of the abscess are those of hepatization; but supposing the abscess to have burst into the bronchial tubes, the pus of course escapes, and a cavity filled with air is left communicating with the bronchial tubes, and this new state of parts gives rise to a new series of phenomena. The air, for instance, having penetrated into the cavity, the part which returned a dull sound, while the abscess was yet unbroken, will now return a sharper and clearer sound on percussion than natural, denoting a larger admission of air than even in health. Again, on auscultating the chest, we find some changes have taken place both in respiration and in the transmission of the voice. If the cavity, for example, be large and the opening small, the natural respiratory bruit at that part will be superseded by a sound resembling a person blowing into a decanter, and from this circumstance termed, by Laënnec, "râle amphorique," or "bottle sound."

Again, if the cavity be large and its walls dense, and the abscess still contains some pus, we hear a sound as if a drop of water had fallen into a pool; and this sound is so sharp and metallic, that it has received from Laënnec the term "tintement metallique," or metallic tinkling. It is usually supposed that this sound is produced by a globule of pus dropping from above into the fluid below; but some pathologists are inclined to believe that it is owing to the bursting of a bubble of air, mixed with the pus of the abscess. Another phenomenon is, if the abscess be large, and contain some pus, that, on the patient coughing, we actually hear the "wabbling" of the pus against the walls of the abscess. The last of these singular circumstances developed by auscultation is, if a large abscess be situated at the superficies of the lung, and the walls of that abscess be thin and not adherent, the auscultator has the disagreeable sensation of somebody sucking air out of his ear at the end of the stethescope, and this has been termed by Laënnec "souffle voilé." This striking symptom enables us to determine not only that there is an abscess, but that abscess is superficial, and its external wall not adherent; so we may affirm, if other symptoms indicate the presence of an abscess, and this symptom be absent, that the abscess must be deep-seated, or, if superficial, must be adherent.

The next remarkable circumstance revealed by auscultation in the event of an abscess is *pectoriloquy*, which is, that on the stethescope being applied to the chest, and the patient desired to talk, we hear his voice as if he were directly speaking at the end of the stethescope, the sound passing directly to the ear as through an ear-trumpet. This phenomenon results from the same cause as that which makes the aneurismal sac pulsate stronger than the healthy artery itself; or supposing the capacity of an artery to be as 6, and the aneurismal sac as 12, and the moving force as 3, the artery will pulsate with a force equal only to 18, while the sac will pulsate with a force equal to 36. In like manner, the vibration of air will be so much stronger in the empty cavity of an abscess as the cavity itself is larger than the bronchial tube; and hence this greater vibration of air is powerful enough to occasion a distinct vibration of the walls of the stethescope, and consequently a direct transmission of the voice to the ear.

Pectoriloquy, however, does not take place in all cases of abscess of the lung, but may be considered the exception rather than the rule of this disease. The

Elementary Principles of Medicine.

Elementary Principles of Medicine.

cause of this is, that many conditions are necessary to its existence; first, that the lung must be condensed so as to have some conducting power, or else the voice will be destroyed, as in health, before it reaches the aperture communicating with the abscess. Again, it is necessary that the patient should have a sufficient quantity of voice to produce strong vibration; but this is often wanting. Another condition is, that the bronchial opening of the abscess be not too large, for in that case the vibrating force is diminished, and instead of representing a power of three to a square inch, it will now perhaps be reduced to a power of one to a square inch. It is likewise injurious to the effect that there be more than one opening into the abscess; for in that case not only is the vibrating force diminished, but the counter-currents destroy all vibration, as has been instanced in an effervescing glass of champagne. It is plain also that the walls of the abscess must have a certain density, or else their flaccidity will act like a damper, and destroy all vibration. Many conditions, therefore, are necessary to pectoriloquy; and we cannot feel surprised that one or more may be wanting, and the phenomenon in question frequently absent.

Besides an opening into the bronchial tube, the abscess may at the same time open into the cavity of the chest, producing what has been termed a triple opening, and this new pathological state gives rise to a tintement métallique of the chest infinitely more powerful than that caused by a pulmonary abscess. Indeed the intensity and sharpness of the sound quite equals that returned by a copper vessel when struck with a slight force; for the intercostal muscles, irritated by the air and pus in the pleural cavity, brace the walls of the chest like a drum, so that they become an excellent conductor of sound. The immediate cause of the sound is supposed to be exactly the same as when it results from an abscess, either a drop of fluid falling into the pus below, or else the extrication of a bubble of air from the gravitated pus. The chest in these cases always returns a remarkably clear sound on percussion.

In *Pleuritis*, auscultation and percussion are equally valuable in determining the amount of effusion, and sometimes the nature of the effusion. If serum or pus be effused to the amount of a pint, the lung is displaced to that extent; and consequently the lower portion of the chest, when struck, returns a dull sound, which extends as high as the level of the fluid. If we now auscultate the patient, the respiration is also lost below the level of the fluid. Besides these results, the voice gives very striking indications of the lung becoming condensed from the presence of the fluids; for we very constantly have bronchophony, and occasionally ægophony. In the latter case the voice, instead of being articulated, as in bronchophony, is broken, vibratory, and inarticulate, so that it has been compared to the bleating of a goat, or to the nasal vibratory notes of Punch, and hence it has been termed by Laënnec *ægophony*. This symptom has been supposed to be caused by oscillation of the fluids in the chest incessantly altering the diameter of the bronchial tubes of the compressed lung.

When the effusion is so considerable as to form empyema, and the cavity of the chest be only partly filled, we sometimes have, as in a case now in St. Thomas's Hospital, a tintement métallique. It has been thought that a triple opening was in all cases necessary for the production of this sound, but in the patient alluded to there was no reason whatever to suspect abscess of the lung. In a similar case that died some years ago in the same hospital, although the tintement métallique was most marked and complete, yet on examining the patient no air passed from the lung into the chest, even when the lung was inflated after the cavity of the chest had been filled with water, neither could any trace of an abscess or of an ulcer of the lung be found. The presence of air is perhaps necessary to this phenomenon, but this may be generated by putrefaction, or be extricated by secretion, and consequently a communication with the external air is not essential.

If the chest be completely filled in empyema, the respiratory sound is altogether wanting; so is ægophony and bronchophony, and the containing cavity returns a dull sound at whatever part percussed. Under these circumstances, and especially if the heart be transposed, the patient should be undressed, when the affected side will be seen entirely motionless, rounded, and distended; and when these signs are present there can be no doubt of the disease being either empyema or hydrothorax.

Besides pus being effused into the chest, lymph may be thrown out in a more or less solid state; and this morbid result gives a rubbing sound, as though the play of the lung was impeded by a rough uneven surface. Such are the physical symptoms accompanying pneumonitis.

Diagnosis.—It is hardly possible to confound bronchitis with any other disease; but there is often much difficulty in assigning its cause, and distinguishing it from phthisis. The quietness of the pulse, however, the absence of great emaciation, and the clear resonance returned on striking the chest, are the best diagnostic symptoms. Pneumonia is distinguished from phthisis by the previous good health of the patient, and by the more acute nature of the disease; and, in some degree, by a difference of its seat, the lower lobes being more particularly affected in inflammation, the upper lobes in phthisis. The two diseases, however, it should be remembered, are often combined. Pleurisy is distinguished from the other forms of pneumonitis by pain, and by the very distinct evidence of effusion afforded by auscultation and percussion.

Prognosis.—Bronchitis is not often fatal in young persons, unless it is connected with phthisis. In the aged, however, it is often combined with disease of the heart or other affection, and is often fatal. Chomel says, he lost 40 cases out of 123 in one instance, and 38 out of 96 cases in another. It is supposed that one in three die when attacked with pneumonia or pleuro-pneumonia. Louis lost 28 out of 78; but this varies greatly in different years. A large proportion of those attacked by pleurisy recover, but the numbers are not determined. Andral observes, that pneumonia of the superior lobe is more grave than pneumonia of the inferior lobe, and this arises from two causes; first, in the young the superior lobe is often previously diseased, while, according to Louis, pneumonia of the superior lobe is one of the contingencies of old age.

Treatment.—The treatment of all the forms of pneumonitis varies according as the disease is acute or chronic, and according as it depends on simple inflammation, or on a morbid poison, conditions which it is often extremely difficult, sometimes impossible, to determine, and which consequently greatly embarrass our practice.

Abundant experience has shown that large bleeding in acute *bronchitis* uniformly weakens the patient without greatly influencing the disease. Neither has medicine any very marked effects in the cure of this disease; for although some persons rapidly get well under a given treatment, yet many other similar cases, under exactly the same treatment, will run on for weeks, and perhaps for months, without any amendment. In the most acute cases of bronchitis, however, some blood should be taken from the chest either by cupping or leeches, and in general 10 to 12 ounces are sufficient; and in acute cases the quantity of fibrine of the blood is increased from 3 to 6, 7 and 9. After this a blister should be applied to the chest, and, on its being removed, a large linseed poultice should be placed over the blistered part, and continued for many hours, which will not only keep the ulcerated surface open, but gratefully foment and relieve the patient. In the medical treatment, some opiate after the bleeding is necessary to allay the cough; and any preparation of opium, as extracti opii or morphine, or else the syrup of poppies, or of any other narcotic, as of hyoscyamus, or of conii, should be given in moderate doses, every four or every six hours. It is usual also to add to each dose a grain of ipecacuanha, or $\frac{1}{4}$ of a grain of antimonii c. potassio tartarizati, or else some neutral salt, as the liquor. ammoniæ acetatis, ℥ ſs., or the magnesiæ sulphatis ʒ j., according to the state of the bowels. In a few instances, small doses of mercury are beneficial.

In chronic cases of bronchitis the blood is found to be natural in its proportions. After blistering, and perhaps poulticing the chest, the treatment is in general more tonic; as the mist. cascarillæ ter die, or the infus. rosæ c. oxymellis scillæ ʒ ſs. c. tinct. hyoscyami ♏ xv. ter die. Ten grains of benzoic acid out of mist. amygdalæ is another useful remedy, and the mist. ammoniaci or the mist. assafœtidæ are often beneficially employed. If the cough be greatly troublesome syr. papaveris ʒ j., or confectio rosæ may be given almost *ad libitum*.

The treatment of *Pneumonia* is one of the most discordant points of medicine. Most practitioners, finding the blood well buffed and the fibrine increased to five, six, seven, eight, and nine parts, instead of three, treat it by large bleedings; while Laënnec and Louis seem to deduce from their experience that large bleedings are by no means an eminently successful practice, and that in some cases they are absolutely injurious; and the same difference of opinion is held with respect to large doses of antimonii c. potassio tartarizati. These discrepancies are painful, and can only be explained by the circumstance that pneumonia perhaps more frequently depends on the action of a morbid poison than is generally believed.

The ancients bled in pneumonia, and sometimes to deliquium, and Galen appears to have adopted this practice. This was also the practice of Sydenham; and Laënnec says it was common in France at the beginning of the last century to take 24, 30, and 36 ounces of blood at one bleeding. This practice is, within certain limits, followed throughout Europe at the present day, and there can be no question of its propriety in some cases of simple inflammatory pneumonia; but it appears to be a great error to make excessive bleeding the basis of the cure in all cases.

In epidemic pneumonia, says Laënnec, it is hardly possible to bleed the patient without rendering him worse. In 1814 pneumonia was very common among the conscripts, yet there were few indications for bleeding, and those that were bled were rendered so much worse that, says Laënnec, "Je n'osai pas la réitérer." It is probable under similar circumstances that Louis bled, and was equally dissatisfied with the result he obtained. It will be plain, then, that with respect to bleeding, much must be left to the discretion of the practitioner. That there are cases in which the patient can only be saved by energetic bleedings everybody must admit, while, on the contrary, when pneumonia is epidemic the quantity of blood drawn must be greatly limited and the case well watched. The ancients held that bleeding should not be practised after the fifth day, as it prevented *concoction*. The cases of Louis appear to establish the propriety of early bleeding as a general rule; for he says those bled in the four first days of the affection are cured four or five days sooner than those who are bled later in the disease.

It is rare that the cure of pneumonia is left entirely to the influence of bleeding. Rivière used to treat pneumonia by giving the patient an emetic every day or every other day, a practice which has at all times had many partisans. Senac being told by his son that he bled too little and gave too many emetics in pneumonia, abandoned his own plan, but with so little success, that he exclaimed one day, "You have made me a worse physician than I was before." We owe to Rasori the introduction, in modern times, of large doses of emetic-tartar in the treatment of pneumonia. Laënnec was so dissatisfied with his own results of bleeding that he adopted it, and thus describes his practice:—

"As soon as the disease is determined, if the patient be in a state to bear bleeding, I take from eight to sixteen ounces of blood from the arm. I do this as momentarily arresting the inflammation, and thus giving the tartar-emetic time to act, and I rarely repeat this bleeding. Immediately after this bleeding I give the first dose of tartar-emetic, or a grain in two ounces and a half of orange-flower water, and I repeat this dose every two hours for six times; I then allow the patient to repose for six or seven hours. If, however, the disease be severe and the oppression great, I continue it every two hours till the symptoms are mitigated, increasing the dose from one to two grains, or even to two grains and a half. The immediate effects of this practice were, that the larger number of patients vomited two or three times, and had five or six stools on the first day, but afterwards the evacuations were trifling, and when tolerance was established they often required purgative medicines, while many bore these large doses almost without vomiting or experiencing any purgative effect. The result was, that Laënnec cured 27 cases out of 28 in 1824 and in 1826.

The great success obtained by Laënnec appears, however, to have been of short continuance, for M. Lagarde has published an account of 16 cases treated by Laënnec by this method, of whom 5 died, while Lecoultreux has given a list of 30 cases, likewise treated by Laënnec, and of whom 12 died. Neither have other physicians in other years been more fortunate, for Louis treated 15 cases according to this method, and 6 died; Chomel, 140 cases, and 40 died; while Gueneau de Mussy treated 90 cases, of whom 38 died. Andral has likewise treated a considerable number of cases of pneumonia by tartar-emetic, in quantities varying from 6 to 32 grains in the 24 hours; and he adds, I

Elementary Principles of Medicine.

have seen but two unpleasant or grave accidents result from these large doses. Sometimes the patient has not been at all affected, has neither had nausea, vomiting, or diarrhœa, or abdominal pains; at others he has suffered from nausea and distressing vomiting, effects which have subsided on omitting the medicine. Tartar-emetic, he adds, may therefore be given with impunity. But is it useful? I have not, he adds, seen pneumonia ameliorated by large doses of this medicine; for neither has it appeared to do good when borne by the stomach, nor when it has excited distressing nausea and vomiting. Bouillaud rejects it altogether, and prefers large bleedings, by which means, he says, he recovered 90 patients, and lost but 12.

Having thus stated the practice of these eminent physicians, it only remains to add our own opinions of the best mode of treating pneumonia. The quantity of blood drawn varies greatly according to the season; in London, however, it is seldom necessary to take more than from 16 to 30 ounces of blood, and these, if the symptoms demand it, should be drawn as early in the disease as possible. It is seldom right, however, to trust to bleeding alone; and it has appeared to us that a combination of antimony and calomel has saved a much larger number of cases than antimony alone; a quarter of a grain, then, to a grain of antimonii c. potassio tartarizati, combined with one grain of calomel, given every four or every six hours, according to the severity of the disease, is by far the best treatment. In cases of simple serous pneumonia even simpler remedies are sufficient; and two grains of ipecacuanha given 6[tis] vel 4[tis] horis have frequently been followed by the recovery of the patient.

With respect to counter-irritation, the greater number of physicians, says Laënnec, regard blisters as next to bleeding in combating pneumonia; but I, he adds, rarely employ them, for they seldom appeared to cure the patient, while they too often seemed to augment the fever and the partial congestion; while Louis says blisters have no evident action in the cure of pneumonia.

The diet in pneumonia should be slops; the chamber kept warm, but not hot.

Treatment of Pleuritis.—In acute pleurisy the best practitioners of all times and of all countries have taken blood from the arm; and if, says Laënnec, after one or two bleedings the pain in the side and fever have not abated, blood should be taken from the side by leeches or by cupping. Cupping, he adds, is however much better than leeches, for it is more prompt, less painful, and we can take the exact quantity of blood we wish for. Leeches, on the contrary, are long in drawing and uncertain in the quantity they take, sometimes filling rapidly, and then again hardly biting; while in other instances the bites will cease to bleed as soon as the leech is off, while in others again they continue bleeding for 24 hours. The practitioner should remember that effusion often takes place after bleeding in consequence of a subsidence of the inflammation, so that the breathing is often more oppressed and the symptoms for a time aggravated, although the patient is in reality better. The lung, however, soon gets accustomed to this new state of things; and the fluid in a few hours beginning to be absorbed, the symptoms are now generally ameliorated.

Tartar-emetic, says Laënnec, is in general well supported in pleurisy, and contributes powerfully to assuage the inflammatory orgasm; but nevertheless, when the pain in the side and fever have ceased, it loses all further power over the disease, at least does not appear to promote the removal of the fluid effused, so that he always abandoned its use as soon as the acute symptoms had passed away.

With respect to the application of blisters, Laënnec objects to their use until the acute stage is passed; but when the pain has ceased for some days, and absorption of the fluid proceeds slowly, and the disease promises to become chronic, he now applies a blister. Louis says we may neglect them without any sensible inconvenience.

Such is the treatment recommended by Laënnec. There can be no question, however, after bleeding the patient from 10 to 20 ounces, according to the severity of the case, that calomel is a more powerful remedy than tartar-emetic, and that five grains of calomel, once, twice, or more times a day, often stops the inflammation, saves a great deal of blood, and often, indeed, the patient's life; and supposing effusion of serum to have taken place, it is the best absorbent we possess, especially when combined with the bitartrate of potash, neutral salts, or other diuretic.

Should empyema have taken place, and pus be effused to such an amount as to make it impossible to hope for its removal by absorption, the operation of paracentesis of the chest ought to be performed. Laënnec says the space between the fifth and sixth rib, counting from above downwards, should be selected,—being the most depending part of the chest when the patient lies on his left side, which must be considered his more usual position in this disease. When the chest is punctured the pus should be entirely evacuated; at least no advantage results to the patient from any portion of it being retained, for even when the heart is displaced no adhesions have yet been observed so strong as to prevent it resuming its place as the pus flows. After the pus has been drawn off, the great difficulties of the further treatment arise out of partial adhesions of the lungs preventing the escape of the matter, and consequently the closing of the wound. It may be questionable whether a probe ought not to be introduced to break down the attaching parts, and also whether injections of tepid water might not be used advantageously to bring away the putrid or thickened matters contained within the chest.

The diet of the patient while labouring under acute pleurisy should be slops; after, however, the operation of paracentesis of the chest he should have a liberal support of wine as well as of animal food.

Of Inflammation and other simple Organic Diseases of the Heart.

The anatomy as well as the pathology of the heart and large blood-vessels begins with Harvey; but the subject can hardly be said to have taken a scientific form till the beginning of the present century, when the work of Corvisart appeared, followed by that of Burns in England, of Testa in Italy, of Kreysig in Germany, and of Bertin and more especially that of Laënnec in France; and a large school has been since formed in Europe by the labours of these eminent pathologists.

The inflammations of the heart embrace Pericarditis, Carditis, and Endocarditis. 3788 cases are reported to have died of these diseases in England and Wales in the year 1839, a number evidently infinitely below the

truth, and shows how imperfectly this class of disease is yet studied and known. The knowledge, indeed, of the profession generally respecting carditis and of pericarditis is too unsure, and our description of them consequently too desultory to allow us to treat of the inflammation of the heart in the same concise manner as we have done those of the lung, and compels us to describe each form of carditis under a separate head.

Of Pericarditis.

Pericarditis is an inflammation of the serous membrane containing and covering the heart *externally*. The total number of persons reported to have died of this disease in 1839 was 135, so that this affection is extremely rare.

Remote Causes.—The pericardium is acted upon by a few morbid poisons, as the paludal poison, perhaps the poison of the plague, of the small-pox, of scarlet fever, and of scurvy. The most common cause of pericarditis is the rheumatic or gouty virus; and the diseases of the pericardium arising from those causes will be treated of under the head of Rheumatism. The other causes are extremely undetermined, and perhaps are to be referred to general causes acting upon a peculiar idiosyncrasy; thus pericarditis is often connected with albuminous urine dropsy. In other cases it has appeared connected with powerful moral emotions; one lad died of this disease after receiving a good starting, but he might have been ill before.

Predisposing Causes.—All ages are perhaps liable to pericarditis; but it is scarcely known in infancy, and is only occasionally seen as a primary disease in children above six years of age. When it arises from albuminous urine dropsy, rheumatism, or the paludal poison, it is most common between 20 and 40. Men appear to suffer more than women, and nearly in the ratio of three to two.

Pathology.—The pericardium, like all other serous membranes, is liable to the diffuse, the serous, the adhesive, and to the purulent inflammations. These different degrees of inflammation may exist *per se*, but it sometimes happens that they all co-exist in different parts of this membrane at the same time. They may be acute or chronic.

If the patient falls from acute diffuse pericarditis, the inflamed portion is of a bright rose-colour. This redness is in the first instance caused by the increased vascularity of the subjacent cellular tissue; but as the disease advances red blood penetrates the serous membrane, first punctuating it with a number of dots, which become confluent, and form patches that extend till perhaps the whole membrane is one bright scarlet. Besides being red, the membrane is thickened, first from interstitial deposit, and then from incorporation with the sub-serous tissue; and it is now opaque, white, thickened, and readily detached from the heart.

The diffuse inflammation may terminate by resolution; but more commonly it passes into the serous inflammation, the quantity of serum effused varying from a few ounces to a few pints. Louis has given one case in which it amounted to four pounds, and Corvisart another in which the quantity was still more considerable.

The adhesive inflammation often co-exists with the preceding inflammation, and lymph is now thrown out, and generally in much greater quantity than from any other serous membrane. The lymph thus extravasated may be only in such quantity as to render the serum turbid, or else so extremely loose in texture as to float in it; more commonly, however, it is disposed as a membrane, often covering both surfaces of the pericardia, and especially that covering the heart, and often amounts from two to many lines in thickness. This mass, when considerable, presents a remarkably irregular appearance, and which has been compared to the stomach of a calf, to a portion of a honey-comb, or to two pieces of marble united by grease and forcibly separated. If the patient falls in the acute stage this membrane is found only slightly coherent, and very rarely exhibits any trace of organization.

The highest degree of acute inflammation is when pus is effused, which is generally of a laudable healthy character, though sometimes of a greenish hue. The quantity effused is very various, sometimes only a few ounces, but at others so abundant as to fill the pericardium.

In the chronic forms of the disease all the above morbid states may be observed; but when lymph has been effused it is now commonly found organized, so that the pericardium is often partially or universally adherent all over the heart. In some instances the lymph effused, instead of forming adhesions, becomes converted into cartilaginous and even osseous patches, which are readily detached from the surface of the heart by the scalpel; and in a few rare instances the connecting cellular tissue of the pericardium is so extensively ossified that the muscular walls of the heart have been partially or generally converted into one unyielding mass of bone.

The acute forms of pericarditis sometimes involve the muscular walls of the heart, so that on cutting through them the muscles are seen for a greater or less depth of a deeper colour than usual, and their texture is also impaired, the finger readily passing through them. In chronic inflammation, on the contrary, their colour is sometimes lighter than usual, and their texture firmer.

With respect to the relative frequency of the different forms of inflammation, Louis states he found the fluid effused altogether serous in nine cases, sero-sanguinolent in five, sero-purulent in 15 cases, and pure pus in seven cases; while false membrane or lymph was effused in greater or less quantity in nearly all the cases.

General Symptoms. — The symptoms of pericarditis vary, according to most authors, as the disease is the result of rheumatic or of simple inflammation; the symptoms in the former case being extremely well marked, while in the latter they are exceedingly obscure. They are both physiological and physical.

When pericarditis is the result of rheumatism, its most marked characteristic is pain more or less severe in the præcordial region; and from this point it radiates over the whole of the sternum, sometimes extending to the brachial plexus and down the left arm. This pain is accompanied by a sensation of the whole chest being constricted, and by an incapacity to take a long breath, or to cough. From these causes the patient is restless and anxious, his pulse varying from 90 to 110, full and strong, but often intermittent or otherwise irregular; and this state of things having lasted from three or four days to a week, the patient often dies suddenly, with or without his mind having previously wandered.

When acute pericarditis is the result of simple inflammation, the patient suffers no pain, and the symptoms are often most obscure, general as well as physical. Even when the disease is most unmixed, it has been mistaken for a common fever, for pleurisy, and even for

uteritis. Its abrupt attack, its rapid course, the absence of local pain, and its sudden termination, hardly allow time to fix the seat of the disease. A few instances will best exemplify these assertions.

A sailor boy, who had a few days before received a good starting, was admitted into St. Bartholomew's Hospital. He made no complaint of pain, and he was supposed to labour under typhus fever. During the 36 hours he lived, he was many times sane and insane, and at one time he rushed to the window with an intention of throwing himself out, and then again sunk so low that wine was given to support him. His pulse was at one period rapid, as in the last stage of typhus, and then subsided to 90 or 100. He died, and the only disease was inflammation of the pericardium; lymph, pus, and serum being effused into its cavity.

A lady, says Mr. Burns, after a slight bowel complaint, miscarried. This was followed by vomiting, and the next day she complained of wandering pains on the right side of the chest. Two days afterwards she complained of headache, as well as of most excruciating pain of the pelvis, and the lochial discharge was almost entirely suppressed; she became delirious and died. On examination the uterus was found healthy, the lung of the right side where the pain was first felt was tuberculated, while the pericardium contained a quantity of flaky fluid resembling pus. Rostan thinks the symptoms of acute pericarditis, when not caused by rheumatism, are so obscure that its existence is only to be determined "per exclusionem," or by first determining what the disease is not, we may at length infer that it can be nothing else than pericarditis.

With respect to chronic pericarditis, we are in many instances at a loss to know what symptoms mark its commencement or attend its course. Laënnec says, he has frequently found the pericardium full of pus from chronic inflammation, without any symptom leading him to believe that any such disease existed. When the two pericardia adhere, the symptoms are also equally obscure. In most cases, if the disease be partial, little inconvenience is felt; and even when the adhesions are universal, the patient, though perhaps suffering from occasional palpitation and dyspnœa, yet more commonly falls from some remote disease, as dropsy or affection of the lung. In old adherent pericarditis it is generally supposed that the irritation caused by this morbid state of parts must produce a great flow of blood to the heart, and consequently that it must be enlarged and hypertrophied. It is doubtful, however, whether the fact corresponds with the theory, for many cases have been observed in which, when thus affected, the heart has been diminished in size and its cavities contracted.

The duration of acute pericarditis is from two or three days to two or three weeks. Chronic pericarditis may last many months, and often perhaps many years.

Physical Symptoms.—In the difficulty which exists in ascertaining the physiological characteristics of pericarditis, the mechanical functions of the heart afford some physical symptoms which are most useful in determining the existence of this disease as well as others of this organ. The intermittent action of the heart, for example, causes vibrations in its walls which give rise to two natural sounds, termed its bruits. These bruits are best heard when the heart beats about 60; when, however, its pulsations are more than 100, the sounds run more or less one into the other, and to most ears are now confounded. One of these sounds is short and clear, and is termed the *auricular* sound; the other is longer and duller, and is termed the *ventricular* sound. The cause of these sounds has been much debated by pathologists, some attributing them to the action of the valves, others to an active state of the muscles of the heart, both when it contracts and when it dilates, and others again to the circumstance of the blood passing from a larger into a smaller cavity, while Majendie conceives them to arise from the impulse of the heart against the ribs. It seems probable, however, that the causes of the heart's sounds must be multiplex; and as the rush of the water, the vibration of the cylinder, and the clicking of the sucker are united in the sound of pumping, so the rush of blood, the vibration of the heart's walls, and the play of the valves must all be concerned in the production of the sounds of the heart. Still, on whatever cause these sounds depend, they are liable to be much altered, and in 49 cases out of 50 these alterations denote a diseased state of the valves. Again, the heart knocks against the ribs, or has impulse; and this *impulsion*, when greater or less than natural, determines the walls of the heart to have an increased or diminished thickness. The impulsion also may be accompanied by a rubbing sound, termed "bruit de frottement;" and this is supposed to denote an effusion of lymph. Another condition of the heart is, that it moves in a given *space*, and when this space is much greater than natural it denotes that effusion of pus or of serum has taken place. Lastly, the heart is a solid body, surrounded on three sides by lung; and consequently, when the portion of the chest immediately above it is struck, it returns a dull sound, while all around returns a clear one; and this enables us to determine the extent of the effusion, or, when that is wanting, the *size* of the heart. Such are the physical signs of the heart's action, and according as they are present or absent, modified or natural, we derive much assistance in determining the existence of pericarditis. Thus it is generally supposed we can determine by these symptoms whether any and what effusion has taken place into the pericardium. If, for instance, diffuse inflammation exists, it is denoted simply by pain, but without any other local symptom; if serum be effused in any considerable quantity, the pulse is still strong, and varies from 90 to 100, while the heart feels as though moving in a large space, together with "son mat" of considerable extent on percussion; if lymph is thrown out, a rubbing or cracking-of-leather-sound is heard; while, if pus is effused, the pulse is small and frequent, 120 to 130; and the heart is felt once more beating over a great extent of the chest, which gives a "son mat" on percussion. In general the pulse is accompanied by a bruit, and these symptoms continue till death closes the afflicting scene.

Diagnosis.—When pericarditis results from acute rheumatism, the only disease with which it can be confounded is angina pectoris; but the attack of rheumatism readily distinguishes them. The difficulty of the diagnosis in other forms of the disease has already been stated.

Prognosis.—Acute pericarditis from rheumatism is seldom fatal, if properly treated; but when it arises from any other cause it is far less tractable. Still, however, it is often compatible with life; for Louis found, on examining 443 bodies of persons that had died of other disease, traces of pericarditis in 1 in 11, a circumstance which shows that it is often recovered from. It must be admitted, however, that this disease renders the party

prone to affections of the chest, and also to dropsy, and consequently it is an ultimate means of shortening life, although the patient may enjoy many intervals of perfect health.

Treatment.—The treatment of acute rheumatic pericarditis consists in moderate bleedings, and in the exhibition of calomel till the mouth is affected; but this will be treated of more fully under the head of Rheumatism. The treatment of acute pericarditis, the result of simple inflammation, is perhaps not dissimilar, but the cases are so few, and as yet so imperfectly observed, that the methodus medendi can hardly be said to be determined. In the more chronic forms of this affection, the mischief is for the most part irremediable; but the dropsical symptoms admit of much relief from the dried seeds of the iberis in three-grain doses three times a day; also from æther, digitalis, the bitartrate of potash, and perhaps from small doses of mercury.

Of Carditis and of other Simple Organic Diseases of the substance of the Heart.

Carditis is an inflammation of the muscular structure of the heart, and is extremely rare as an idiopathic disease.

Remote Causes.—The remote causes of this affection are rheumatism, probably violent moral affections, drunkenness, together with previous existing disease of the pericardium: the substance of the heart is also acted upon by the poison of the plague and of the small-pox.

Predisposing Causes. — These affections have in general been met with in early adult age, and rarely beyond the age of 50.

Pathology.—The muscular structure of the heart is liable to the diffuse, the adhesive, the suppurative, the ulcerative, and to the gangrenous inflammations. The cases of diffuse inflammation from acute rheumatism are numerous, but the cases recorded of the other forms of inflammation are too few to enable us to give any satisfactory generalization of their phenomena. The relation, however, of a few individual cases will establish the liability of the heart to the inflammatory diseases that have been mentioned.

M. Simonet has recorded a case of *suppuration* of the heart, in which the disease appeared to result from rheumatism. The patient, a woman, was brought to the hospital labouring under most tumultuous action of the heart, with a pulse irregular and contracted, her breathing oppressed, and her extremities cold. She was bled, but died in a few hours in a fit of syncope. Several purulent collections were found in the substance of the heart, and especially in the interventricular partition. The internal surfaces of the cavities were red in several places; the muscular structure was of a yellowish hue, softened, and torn with the least effort.

Dr. Graves was consulted by a gentleman, aged 55, who had complained of palpitation and dyspnœa, and more recently of anarsarca; he suffered also from severe pain and oppression at the region of the heart. Dr. Graves detected hypertrophy and dilatation of the ventricles, and as there was a loud bellows-sound with irregular pulse, he inferred disease of the valves. The patient died suddenly a few weeks afterwards, when there was found, besides hypertrophy, and enlargement of the heart, together with some adhesions, an abscess in the walls of the heart, which contained about two ounces of pus. The valves were generally thickened, but those of the aorta were ossified, while some considerable effusion was found in both pleural cavities.

The last case which it may be necessary to mention in proof of suppurative inflammation taking place in the heart, is one that was examined by Mr. Stanley. In this instance the vessels were loaded with venous blood, and the muscular fibres were of a very dark colour, of a very soft and loose texture, and easily torn by the fingers. On a section of the ventricles numerous collections of dark-coloured pus were seen among the muscular fasciculi. Some of these were seated near to the cavity of the ventricle, while others were more superficial, and had detached the pericardium from the heart. The muscular parietes were also softened, and loaded with dark blood.

Ulceration of the heart has been occasionally seen from an abscess in the walls of the heart having opened either into one of its cavities, or else into that of the pericardium. It has also resulted from the softening of a cancerous tumor, or from a suppurating tubercle. Cloquet has given the case of a man, aged 79, subject to frequent syncope, who died suddenly, crying out fire! thieves! "au feu! au voleur!" and in whose heart there was an ulceration of the left auricle, through which about two pints of blood had escaped into the pericardium.

Ramollissement of the walls of the heart has been occasionally met with. In this affection the heart is flaccid, so that if we make an incision into the ventricles the walls collapse. Its substance also tears with great facility. This disease is almost always accompanied by some change in its colour, which is sometimes deeper than natural, and at others, according to Laënnec, of a yellowish tint, like that of an autumnal leaf,—an appearance which does not necessarily occupy the whole thickness of the muscular substance, but often merely the central layers. This degenerescence is sometimes general, but often partial, affecting only the walls of one ventricle, of the interventricular partition, or else the walls of one auricle. It is from this cause, perhaps, rather than from any other, that the patient sometimes falls from rupture of the heart.

Examples of the rupture of the right side of the heart are more rare than those of the left, or, according to Bouillaud, there are six ruptures of the left side to four of the right side. Rupture of the auricles is perhaps as frequent as that of the ventricles, or, out of the 10 cases mentioned, four were ruptures of the right auricle and two of the left auricle. The extent of the rupture, when it takes place in the ventricle, is very various. In one case the ventricle was ruptured from its apex to its base, along the sulcus which separates the two ventricles. In another, the rupture was from 10 to 12 lines; in a third, the base of the ventricles was severed from the aorta, and one of the aortic valves split transversely. It is remarkable, however, that the rupture has seldom been found at the apex, where the walls of the heart have least force and consistency. The number of the ruptures is as various as their seat; thus out of 48 cases collected by Ollivier, eight were multiplex. Again, in two cases related by Rostan, there were two ruptures in each case towards the apex of the left ventricle. Morgagni gives one case, and Portal another, in which there were three ruptures in the left ventricle, and Andral met with a third, in which there were five ruptures; but of these three were superficial, only two opening into the cavity of the left ventricle.

Corvisart is the first who has given examples of another kind of rupture of the heart, and it is that of the carneæ columnæ, or tendons of the valves; and it is probable that rupture of these parts is owing more frequently to ramollissement, or to induration, than to any other cause. Laënnec, however, mentions a case in which it appeared to result from ulceration. In the three cases related by Corvisart, the rupture followed some violent exertion; and Bertin also saw a case in which one of these tendons was ruptured in consequence of a violent fit of coughing. The first symptom in all these cases has been a sudden sense of suffocation, and the patient has in general suddenly died, although in some instances he has survived a few days.

Induration of the walls of the heart is also an occasional disease of this organ. Bouillaud has collected a series of cases in which this change of structure has been observed. In one the walls of the heart were almost tendinous. In another the carneæ columnæ of the ventricle were so increased in density as to split, "casser plutôt que de rompre." In a third, the walls of the right ventricle seemed to be undergoing a cartilaginous transformation, and Broussais has seen them as hard as a cocoa-nut. The more usual mode of induration is ossification,—a change which usually begins in the coronary arteries, and frequently stops there; but in some rare cases this ossification extends, so that the walls of the auricles, of the ventricles, or both, and sometimes also of the cardiac partition, become converted into bone. There are specimens in the museum of St. Thomas's Hospital which make it remarkable how life could have been continued, looking to the unyielding nature and great extent of the ossification of the walls of the heart.

Hypertrophy is an abnormal increase of the muscular substance of the walls of the heart, and although occasionally an idiopathic disease, is more commonly a secondary affection, caused by disease of the valves. The hypertrophy may be general or partial, that is, may affect the whole heart, or one side of the heart, or one ventricle or one auricle, or the ventricle of one side and the auricle of the other; or else both ventricles or both auricles; or indeed every possible combination of the four cavities. The auricles, however, are much less frequently affected than the ventricles.

The natural thickness of the walls of the left ventricle is in the adult about $6\frac{1}{2}$ lines; but Laënnec has seen them an inch and a half, or 18 lines in thickness at the base, when affected with this disease, or triple the healthy standard. This thickness generally diminishes towards the apex, which latter is often natural; but in other cases even the apex is thickened, and instead of two lines it measures four lines. The carneæ columnæ and likewise the cardiac partition are also proportionably hypertrophied in these cases.

In hypertrophy of the right ventricle the walls are more uniformly thickened than in hypertrophy of the left ventricle; still, however, the increased thickness is always more marked about the tricuspid valves, and at the origin of the pulmonary artery. The greatest thickness observed has been seldom more than four or five lines, which, taking the natural thickness at $2\frac{3}{4}$ lines, is scarcely a two-fold increase. In malformations of the heart, however, it has been found much greater; and both Bertin and Louis have each seen a case in which the foramen ovale was open, and in which the thickness varied from 12 to 16 lines. Besides an increase of thickness, the walls of the right ventricle, when hypertrophied, acquire a greater firmness, so that on cutting through the walls they do not collapse.

Hypertrophy of the heart seldom takes place without an alteration in the size and form of the chambers. These may indeed be natural, but more commonly they are either increased or diminished; or supposing each chamber to measure 10 square inches in health, it sometimes measures from 15 to 20, or even more; or supposing it, when of the natural size, to hold two ounces, when thus diseased it will often contain a large portion of a pint. This state of parts has been termed *eccentric* hypertrophy: and admitting the normal heart to weigh $9\frac{1}{2}$ ounces, the weight in hypertrophy is often double or triple that amount; and Bouillaud speaks of 18, 20, and 22 ounces being not uncommon. On the contrary, hypertrophy sometimes takes place *concentrically*, or at the expense of the cavity of the heart, and from this cause the ventricle has been found so reduced in size as to be not larger than an unshelled almond.

Atrophy.—The walls of the heart may be atrophied instead of being hypertrophied, so that this organ has been found to weigh in one case only four ounces two scruples, instead of nine and a half ounces, while the thickness of its parietes was reduced to little more than a thin membrane. This atrophy may be general or partial. In some cases the atrophy takes place without any notable alteration of the capacity of the chambers of the heart, and this is termed *simple* atrophy. More commonly, however, when the walls are thinned, the chambers of the heart are enlarged, and this is termed *eccentric* atrophy. Again, the whole heart may be atrophied and reduced in size, as is often seen in phthisis. Thus Bouillaud gives the case of a woman, aged 61, whose heart was no bigger than that of a child 12 years old. While Burns gives the case of an adult whose heart did not exceed that of a new-born infant; and this form has been termed *concentric* atrophy.

Dilatation of the cavities of the heart, it has been stated, may exist both when the heart is hypertrophied or atrophied; but it may also exist when the walls of the heart are of their natural thickness. In any case the dilatation may be partial or general. Partial dilatation of the heart sometimes presents many curious phenomena; thus the walls of the right ventricle have been seen divided into two distinct parts, or, as Laënnec has described it, into a sort of hour-glass contraction.

In other cases this partial dilatation is perfectly aneurismal. Corvisart gives the case of a young negro, who died suffocated, and in whom the superior and lateral part of the left ventricle was surmounted by a tumor almost as big as the heart itself. The inner surface of this tumor contained many concentric layers of lymph, exactly similar to those of an aneurismal sac. The cavity of this tumor communicated, by means of a small opening, with that of the ventricle. Laënnec mentions two cases in which a tumor, of a globular form, and the size of duck's egg, was situated at the point of the left ventricle, and communicated with the ventricle by an opening an inch in diameter. In these cases the left side of the walls of the sac presented a continuation of the muscular fibres of the heart, while on the right side they appeared formed by the two pericardia. Laënnec thinks that these aneurismal tumors are formed by ulceration of the internal walls of the ventricle, as in false aneurism of the arteries; others that it is owing to a separation of the muscular fibres, and

the protrusion of the inner pericardium. There are some fine specimens of this disease in St. Thomas's Hospital.

Hydatids have been found in the walls of the heart, beneath the inner membrane. Dupuytren found hydatids in the thickness of the right auricle, forming a tumor, projecting into the cavity, as large as the heart itself. Morgagni found in an old man, who had in no degree suffered from palpitation, syncope, or irregularity of pulse, but had died of acute disease, a serous cyst the size of a cherry, in the walls of the left ventricle.

Fatty Degeneration.—It is not uncommon to meet with the heart loaded with fat deposited between the muscles and the reflected pericardium, especially at the junction of the auricles with the ventricles; also along the trunk of the coronary veins, at the two edges of the ventricles, at the apex, and at the origin of the aorta and pulmonary artery. The right ventricle is often almost entirely covered with it, and even the left ventricle presents a given quantity about its centre. The more a heart is thus loaded with fat the thinner are its muscular walls, so that in some cases, at the apex and at the walls of the right ventricle, the fibrous structure has almost disappeared, and the carneæ columnæ consequently appear to spring altogether from the endo-pericardium. The muscular fibres, however, which remain are healthy.

In other instances the muscular fibre, instead of being displaced or absorbed, undergoes a fatty degenerescence similar to what has been observed in other muscles; and in this case the muscular fibre becomes of a yellowish colour, like that of a dead leaf, and like to that of certain softened hearts. Laënnec has generally found this steatomatous degeneration partial, and limited perhaps to the apex. In a case which occurred at St. Bartholomew's Hospital, the whole heart had suffered from this degenerescence, so that it appeared little more than a fatty bag, and it was quite extraordinary how the organ had continued to act.

Symptoms of Carditis.—Few authors have met with a case of carditis, unless complicated with pericarditis, and no distinction has hitherto been observed between the symptoms of these two diseases. Corvisart says it is impossible to distinguish between these affections. M. Laënnec affords us no assistance in this dilemma, for he considered that no incontestible example of carditis existed; while Bouillaud says he knows of no symptom which is especially characteristic of carditis. The little that is known of *ulceration* of the heart has already been mentioned.

The symptoms of *ramollissement* of the heart are a feebler impulse, a slower beat, and greater dulness of the sounds of the heart. Patients suffering from this affection are usually hypochondriacal, liable to palpitation on the least exertion, and often die from the ventricle rupturing.

The symptoms of *induration* of the heart are—a stronger impulse and a louder sound than usual. This class of patients is greatly subject to angina pectoris.

The symptoms of *hypertrophy* of the heart are local and general. The local symptoms are a more powerful impulsion, a wider range of action, and some change in the sounds of the heart. There is also a greater extent of dulness of sound in the cardiac region, and sometimes a bulging-out of the left side.

The increased impulsion in hypertrophy of the heart is in proportion to the greater thickening of the walls. Thus in slight cases it is only sensible to the hand, while in others the heart "knocks against the ribs," and even raises the head of the auscultator. This greater impulse, also, not only often causes a vibration of the præcordial region, but even shakes the whole of the chest. Besides being sensible to the touch, the abnormal action of the heart in these cases is often sensible to sight, each contraction agitating the patient's dress, and sometimes even moving the bed-clothes. The point of the heart also deviates more to the left, and its motions may be sometimes traced from the second or third rib as low as the sixth or seventh intercostal space.

The increased thickness of the walls of the heart is evidently unfavourable to the transmission of sound; and it is plain, therefore, that in simple hypertrophy, without enlargement of the cavity, the natural sounds will be duller than in the normal state; and also, if the hypertrophy be concentric, or with smaller cavities, that they will be scarcely heard. When, however, the cavities are enlarged, as in eccentric hypertrophy, the sounds are often clear, full, and even much louder than natural.

In hypertrophy of the left ventricle the impulse is stronger immediately under the inferior portion of the sternum than between the fifth and sixth ribs. Lavoisi has laid it down as a sign of hypertrophy of the right ventricle, that there is swelling of the jugular veins, which now pulsate synchronously with the carotids. Corvisart has repudiated this symptom, but Laënnec says he has found it in every case he has seen of hypertrophy of the right ventricle. In general this pulsation is limited to the inferior parts of the jugular veins, but in other instances it has been seen to extend to the superficial veins of the arm. He regards this symptom, therefore, as one of the best diagnostics of hypertrophy of the right ventricle.

In estimating the general symptoms of hypertrophy of the heart, our knowledge of the influence of the left ventricle over the arteries would lead us, *à priori*, to infer that one of the effects would be a disposition to congestion and to hæmorrhage; and that apoplexy, hæmoptysis, and hæmorrhage from the bowels would often result. It appears, according to Bouillaud, that this reasoning is correct; for out of 54 cases of hypertrophy of the heart, 11, or one-fifth, were attacked by cerebral hæmorrhage or central ramollissement. As many, perhaps, suffer from pulmonary hæmorrhage, while a few suffer from hæmorrhage from the bowels. Indeed, on opening bodies that have died of this disease of the heart, we find the abdominal viscera and mesenteric veins loaded with blood. More commonly, perhaps, hypertrophy is connected with many diseases of function, as asthma or dropsy. The causes of this conjunction with asthma are not very well understood; but it probably arises from the circumstance, that when one branch of the eighth pair, or that supplying the heart, is affected, the other branch which supplies the lungs must partake of the disease, and hence asthma. The causes of its conjunction with dropsy is, that the heart acting too forcibly, the capillary system becomes congested, and serum is effused. The conjunction of hypertrophied heart is also very common in albuminous dropsy; but whether it is a primary or a secondary affection has been disputed, some considering the diseased state of the kidneys to be caused by congestion, induced by the state of the heart, while others consider the kidneys to be primarily affected, and the disease of the heart to be caused by the impoverished condition of the blood; and this latter is certainly the most proba-

ble theory. Besides these concomitants, a pouchy or otherwise diseased state of the aorta often co-exists with hypertrophied heart,—the diseased aorta being caused by the abnormal power of the heart, or else the hypertrophy of the heart results from a supplemental force being necessary to compensate the lost power of the aorta. Many persons affected with hypertrophy of the heart suffer severely from angina pectoris, with palpitation, but it is singular that in general the pulse is natural, except the patient be excited, when it is full and strong.

The symptoms of *atrophy* of the heart are also local and general. The local symptoms are, a feeble impulsion of the heart, while its sounds are louder, clearer, and more distinct than in health; the intensity of sound being greater in proportion to the atrophied state of the walls, combined with increase of size of the chambers of the heart. The general symptoms are, slowness of the pulse, occasional palpitation, difficulty of breathing, and tendency to dropsy. It may appear singular, that as nothing can be more opposed than hypertrophy and atrophy of the heart, that dropsy should equally occur in both cases; but the loss of power of the heart causes a remora or stasis of the blood in the capillary system, equally with its excess of power, therefore the same consequences result. This disease, it has been stated, sometimes terminates by rupture of some chamber of the heart.

The symptoms of *dilatation* of the chambers of the heart, when the walls are of a natural thickness, are merely an augmentation of sound, while their *contraction* is known by a diminution of sound. Aneurism of the heart is so rare that its symptoms can hardly be said to be determined. The celebrated Talma, among other affections, had an aneurismal tumor as large as a pullet's egg on the apex, but no such affection was suspected during life. Most of the specimens in our museums have been obtained from the dissecting-room, and consequently without any previous knowledge of the case. It is probable, however, that the symptoms must be some bruit and some frottement conjoined with some irregular action and displacement of the heart. Hydatids of the heart have likewise as yet no determinate symptom; and little is known of the phenomena resulting from fatty degenerescence, except that the pulse is feeble and the impulse trifling.

Diagnosis.—The diagnostic symptoms of carditis, of ramollissement, and of induration of the heart, are imperfectly known. On the contrary, the symptoms of hypertrophy of the heart, and of enlargement of its chambers, are so striking that it is impossible to mistake them; but it should be remembered they are often latent, unless aroused by some mental emotion, or sharp exercise. Hydatids and fatty degeneration, it has been stated, are too infrequent to allow us to consider their diagnostic symptoms as determined.

Prognosis.—It is probable that diffuse inflammation of the substance of the heart often exists, and is often recovered from, but if any morbid product forms in it the prognosis is fatal. Ramollissement, as well as induration of the heart, from the tendency to rupture in the one case, and to ossification in the other, if they can be determined to exist, are always of grave prognosis, although the patient perhaps may survive many years. Hypertrophy, atrophy, or dilatation of the heart, are perhaps compatible with health, till dropsy or hæmorrhage takes place, when the conjoint diseases are either most difficult of cure or else fatal. Hydatids of the heart are fatal, but fatty degencrescence is perhaps compatible with prolonged existence.

Treatment.—What little we know of Carditis would lead us by analogy to imagine that the cure of diffuse inflammation is by bleeding and mercury, so as to affect the constitution. If pus, however, should form, no remedy promises to be beneficial. We possess no determinate remedy for ramollissement, and should such disease exist the best chances for the patient are, attention to his general health, country air, with a liberal diet. An indurated state of the heart is perhaps little influenced either by mercury, or the iodide of potash, or any other alterative medicine; and the treatment consequently resolves itself into mitigating the attacks of angina, by which it is so usually accompanied, by means of opiates, æther, and camphor.

"Of all the organic affections of the heart," says Laënnec, "hypertrophy, with or without dilatation, appears to me the most susceptible of cure. But to obtain this success it is necessary that the physician, as well as the patient, should arm themselves with equal firmness; for it requires no less tenacity of purpose in the latter to support frequent bleedings, and a perpetual fast, than in the former to contend with the opposition of parents or of friends, and the discouragement which must at times take possession of the patient, who must endure this treatment for many months, or perhaps many years."

This treatment laid down, probably theoretically by Laënnec, is certainly not found to be practically beneficial; for bleeding very constantly, instead of quieting the impulsion, only renders the heart more irritable and its action greater. Again, such an amount of bleeding as would affect the heart would probably debilitate the already weakened capillaries in a still greater degree than the heart, and consequently determine the dropsy which so often ensues. As a general principle, therefore, Laënnec's views should be adopted with much caution; for with respect to bleeding, much observation has shown that it is rarely beneficial, except the hypertrophy be accompanied by hæmoptysis; and in such case moderate bleeding, with the inf. rosæ c. tinct. digitalis ♏ viij. to xij. c. magnes. sulphatis ʒ fs. to ʒ j. is the best treatment. When, however, hypertrophy of the heart is unaccompanied by hæmorrhage, we usually find that quiet, with some transient stimulant, as mist. camph. c. sp. æth. nitr. ʒ j. c. sp. ammoniæ aromatici ʒ fs. ter die vel 6^{tis} horis, tranquillizes its abnormal action far more successfully than any other treatment. If the hypertrophy be accompanied by dropsy, the semina iberidis exsicat. gr. iij. to gr. v. are perhaps the most powerful remedy; but should this fail, other diuretics, as the bitartrate of potash, elaterium, or acetate of potash, with squills, may be tried.

No remedy is known for atrophy of the heart, except a generally tonic treatment. Neither is it possible to restore the enlarged chambers of the heart to their natural dimensions, although by care life may be enjoyed for many years. Hydatids of the heart are perhaps irremediable; and fatty degenerescence can only probably be mitigated by an alteration of the patient's habits of life.

Endocarditis is an inflammation of the serous membrane forming the valves and lining the chambers of the heart. The diseases of this membrane are by far the most frequent of all the affections of the heart, and often lay the foundation of all the other forms. Indeed

it may be said to constitute at least 19-twentieths of all the diseases of this organ.

Remote Causes.—The inner membrane of the heart, exposed as it is to the action of many morbid poisons, and also, we should imagine, to many medicinal and other substances taken up by the absorbents and introduced into the circulation, renders it singular that it is not found still more frequently diseased than it really is. Of all classes of substances, however, alcohol has the most striking effects on this tissue; for this fluid is not only proved to be absorbed and actually to circulate in a free state in the blood, but there are few drunkards the inner membrane of whose heart and large vessels is not more or less diseased; so that this fluid probably acts as a specific poison on that part. The rheumatic and gouty virus appears to act upon this tissue, and many persons improperly treated for those complaints often ultimately die of some form of endocarditis.

Predisposing Causes.—It is very rare to find disease of the inner membrane of the heart in children, but occasionally ossification of the valves has been seen as early as 10 years old. As a general rule, however, these affections commence with early puberty; and two boys, about 16 years old, are now in St. Thomas's Hospital labouring under endocarditis. This tendency increases with age, so that there are few old persons the inner membrane of whose heart and arteries is not more or less diseased. Women are by no means free from these complaints, but from their more temperate habits they are less prone to them than men.

Pathology.—As the pathological phenomena of the membrane lining the *right* side of the heart are in many respects different from those of the *left* side, it consequently seems best to consider them separately.

The internal membrane of the left side of the heart is liable to the diffuse, the adhesive, and to the ulcerative inflammations; and these inflammations may attack either the chambers or the valves of the heart, or both; but, like all hollow organs, the orifices and valvular structure are, by a species of preference, by far the most frequent seat of disease. They may be either acute or chronic.

Acute diffuse inflammation of the membrane lining the left chambers of the heart is occasionally seen after the application of a ligature round an artery, for the cure of a femoral or other aneurism; the inflammation thus caused spreading along the serous membrane of the artery till it reaches the heart. This form of inflammation, so demonstrable in surgery, is occasionally seen in medicine, and may invade the chambers either of the auricle, the ventricle, or both. The inflamed membrane is of a bright rose colour, its structure something thickened, and it is more easily detached than usual. The student, however, should be warned that the colour may be simulated by transudation of the colouring matter of the blood, after death, staining the membrane. There is no evidence of the inner membrane of the left chambers being the seat either of serous or of purulent inflammation; for, if those forms do exist, the morbid product is swept away in the torrent of the circulation. It is, however, liable to the adhesive inflammation; and instances are met with of lymph being attached to the inner surface of the left auricle, and in considerable quantities, though perhaps not organized. Another proof of the adhesive inflammation is the membrane of both chambers being occasionally found greatly thickened, silvery, and opaque. Again, this tissue is liable to the ulcerative inflammation; and a student of St. Thomas's Hospital died from this cause a few years ago. In the chronic forms of inflammation this membrane, in a few instances, is found to be the seat of cartilaginous or of ossific deposits.

The valves of the left side of the heart, like the inner membrane of its chambers, are unquestionably liable to the diffuse, the adhesive, and to the ulcerative inflammation, and these may be acute or chronic.

Diffuse inflammation of the valves is often seen, the tissue being of a rose colour and thickened. The valvular tissue is also the seat of adhesive inflammation, both at its free and at its cellular surface. The instances of its occurring at its free surface are extremely numerous and well marked. Thus lymph is occasionally found strongly adherent on the external surface of the valves, and this lymph occasionally becomes organized, forming those fringe-like or fibrinous warty growths which are often met with on the mitral or aortic valves. It is by this process that the three aortic valves, or else the mitral valves, are sometimes found all soldered together; so that, except for the contraction which takes place in all inflamed parts, the orifice would be closed; but, notwithstanding that process, it has been found sometimes a mere slit, or even reduced to the size of a goose-quill; while Corvisart speaks of an instance in which the orifice, which in health is upwards of three inches in circumference, was reduced to three lines in diameter. In other instances only one valve is affected; and this may be turned up and bound to the aorta, or it may be turned down and bound to the inner surface of the heart or it may be rolled up, taking the form of a shell, and two or more of these circumstances may co-exist in the same heart.

Adhesive inflammation of the inner or cellular surface of the valves is seen by their often becoming greatly indurated and thickened, so that their action is much impaired; or these changes may be limited to the fibrous zone which forms the base of the valves, surrounding the aortic orifice with a sort of collar, contracting its diameter as well as impeding the play of the valves. In other cases the thickening may affect the free edge, or else the central portion of the valve, as the tubercula arantia. The most remarkable circumstance, however, connected with chronic adhesive inflammation of the left side of the heart, is the excessive tendency which the valves have beyond all other serous tissues to become cartilaginous or ossified. These new formations sometimes originate in the substance of the serous tissue, but more commonly are deposited in the subcellular tissue connecting the duplicature of the valvular fold. This ossific deposition is not necessarily preceded by a cartilaginous formation, but is most frequently an original abnormal secretion, often containing a good deal of earthy matter. It is deposited in various forms: sometimes in layers, at others in points, and at others in large masses, knobbled or pyramidal, and occasionally acquiring a large size, so much so that Bertin saw one as large as a pigeon's egg. Sometimes the tendons, or the chordæ tendineæ attached to the mitral valve, participate in these indurations, and Corvisart met with one entirely ossified; and when thus indurated and rendered brittle they sometimes rupture, and the patient dies perhaps in a few minutes. The irritation of these deposits often causes the membrane to ulcerate, and the ossific matter, exposed and discoloured by being bathed in the current of the

blood, has been mistaken for caries. Ulceration, however, sometimes takes place superficially without any such irritating cause, and the valves are even occasionally found perforated.

As the diseases of the veins differ greatly from those of the arteries, we should consequently expect that the diseases of the right side of the heart would in many respects differ from those of the left; and this is the case: for although the inner membrane of the right side of the heart is liable to the diffuse, the adhesive, to the ulcerative, and perhaps to the suppurative inflammations, still it is very rarely the seat of cartilaginous or of ossific deposits.

Acute diffuse inflammation of the serous membrane of the right side of the heart has often been seen in surgery, in consequence of inflammation of a vein spreading to the right cavities of that organ: and by many medical writers this is supposed to take place idiopathically. Serous inflammation is not known to exist in the veins, neither is it proved to affect the right side of the heart. Suppurative inflammation, however, does often affect the veins, sometimes forming a long chain of abscesses, and consequently may affect the right side of the heart; but if so, the morbid product is instantly removed, and consequently the fact is doubtful. The adhesive inflammation, however, though by no means so frequent as on the left side of the heart, is far from being unusual. This is evidenced by the tricuspid valve being often found thickened and bound down, so that the auriculo-ventricular opening is greatly narrowed. The sigmoid valves have also been found similarly diseased, so that, instead of being 3 inches in circumference, the pulmonary orifice is so greatly reduced as sometimes not to have exceeded 4, 3, or even $2\frac{1}{2}$ lines in diameter. Lymph has also been found, as is supposed, effused at the free surface of the right auricular serous membrane. Ulceration also occasionally takes place in this membrane, the septum of the heart having been found perforated, and the pulmonary valves occasionally are seen in a similar state.

The cartilaginous and osseous formations so common on the left side of the heart, are infrequent on the right side; still, however, they have been met with, and more especially when from any congenital malformation, or other cause, the right and left sides of the heart have communicated, and the arterial and venous blood of those cavities been mingled. Morgagni gives the case of a young woman, aged 16, in whom the valves of the pulmonary artery were cartilaginous, with a point of ossific matter, and were so adherent that the orifice was greatly contracted. In this case the foramen ovale was open, and the patient laboured under cyanosis, or the blue disease—"Maladie bleu." Vieussens, Hunauld, Bertin, and others, have seen instances of osseous or of cartilaginous indurations of the right side of the heart. But the most extraordinary case of this kind is that observed by Cruwel in an octogenarian. In this case the tricuspid valve was cartilaginous in many points, and osseous lamellæ extended from the base of the right auricle, behind the internal membrane of the right ventricle, of which some of the columns were ossified. Small osseous concretions were also observed in the vena cava. A small globular body, pierced with two openings, with cartilaginous walls, and partly ossified, was *enclavée* between the valves of the pulmonary artery. Some ossifications also existed on the left side of the heart, and in the pericardium.

A diseased state of the valves, whether of the right or of the left side of the heart, is usually accompanied by atrophy or hypertophy of its walls, and also with dilatation of the different chambers of the heart. These abnormal states arise from the circumstance, that any impediment to the circulation situated at the orifices of the heart, or any alteration in the form of the orifice, affects the quantity of blood discharged, and calls on the heart for increased exertion, and thus leads to an alteration both in the strength of its walls and the size of its chamber. Thus, supposing the aortic orifice to be diminished from any cause one-half, it is the law of the discharge of fluids through orifices, that the quantity of blood propelled through them by the same force is reduced to *one-fourth*, and consequently the heart will be required to exert a *four-fold* force, should such an event occur, in order to transmit the usual quantity of blood, and to carry on the circulation. This call on the heart's powers may perhaps be met in some few sthenic individuals, and the walls become so greatly hypertrophied as to supply by an increased velocity the diminished quantity of blood which must otherwise be thrown out at each systole of the heart. But more commonly the heart, even of a powerful man, is seldom long able to contend with a permanent obstacle, and much less so that of a patient of a feeble habit, and consequently the physical force of the heart gives way. In either of these cases, also, a *remora* of the blood takes place in the chambers of the heart, it accumulates, and they enlarge. The most usual alteration is a pouchy state of the ventricle at the insertion of the aorta, so that its orifice is no longer in the direct line of the axis of the heart, and the counter currents, as well as physical obstruction thus produced, still further diminish the discharge. It follows as a necessary consequence, then, that any change in the form of the orifice, or of the ventricle, or any obstruction caused by the valves, necessarily contribute to an hypertrophied or atrophied state of the heart, and to an enlargement of its chambers.

The changes which have been mentioned once established, the evil goes on increasing; for, supposing the chamber of the ventricle to average 10 square inches, and each square inch to exert a force of 4 lbs., the whole force that the cavity exerts at each contraction is 40 lbs. If, however, the chamber of the heart become enlarged to 11, 12, or 15 square inches, the force to be exerted will be increased from 40 lbs. to 44, 48, 60, or even more pounds; thus the distending force increases with the weakness and dilatation of the cavity, and renders a return to a healthy state almost impossible. The heart, then, once enlarged, often continues to increase, till at last its chambers acquire such a size that the valves are no longer capable of closing their respective orifices, and "a permanent patency," as it is termed, ensues; when the column of blood making a constant pressure on the ventricle, the powers of the heart are rapidly exhausted, and the patient shortly dies. The distending force acts equally, or nearly so, on all parts of the dilated chamber; but if the walls of the heart be enfeebled at any given portion, that portion sometimes giving way, the heart may rupture, or else the aneurismal tumors of the heart that have been mentioned form. Such are the mechanical laws which govern this class of disease.

Symptoms.—The cases of acute inflammation of the inner membrane, lining the chamber of the ventricle or of the auricle, are so few that their symptoms are by no

means determined. They are generally, however, considered to be delirium, fever, and an exceedingly irregular pulse, together with much anxiety and oppression at the præcordia.

Acute inflammation of the valves of the aorta is seldom seen, except combined with rheumatism; and the physiological symptoms are pain or angina of the chest, while the physical contractions of the heart are marked by a "bruit de soufflet."

In chronic inflammation of the valves there is no pain, nor is it until the play of the valve is impaired, or the orifice contracted, that it gives rise to any well-marked physiological or physical symptom. The physiological symptoms are—a frequent irregular pulse, occasional palpitations, asthma or cough, with bronchitis. These disordered actions of the organs of the chest are at length followed by the capillary system giving way, either from sympathy with the diseased state of the heart, or else from mechanical congestion, and hæmorrhage and dropsy are the most frequent consequences, so that the patient most commonly dies either from apoplexy, or hæmorrhage from the lungs or bowels, or else from hydrothorax, ascites, or some more general form of dropsy. It is remarkable, however, that as soon as the dropsical effusion has taken place, the pulse generally becomes slower and the bruit less loud. But these apparently favourable symptoms are not followed by any amendment; on the contrary, the dropsy increases, and the two diseases quickly destroy the patient. It is singular, also, and marks an advanced stage of the disease, that the pulse is in many cases not synchronous with the systole of the ventricle, which shows that in disease the arteries have an action independent of that of the heart.

The physical symptoms which denote a diseased state of the valves are, the peculiar bruit and the impulsion. In health it has been stated that the contractions of the ventricle are accompanied by a peculiar sound, and that of the auricles by another; but when the valves of the heart are diseased, these natural sounds are changed into what is technically termed a "bruit," or an abnormal modification of the natural sounds. The peculiar character of the bruit depends on the degree in which the orifice is contracted, and also on the state of the valve itself, or whether it be rough or smooth. If smooth, we have generally a "bruit de soufflet," or bellows-sound; if, on the contrary, the valve be fringed, or ossified, or otherwise irregular, we have a rasping, filing, whistling, and sometimes even quite a musical sound. The rule for determining the particular valve affected is, if the sound be heard loudest on a level with the lower edge of the third rib, and a little to the left of the mesial line of the sternum, it is the aortic valve which is affected; and on the contrary, if the sound be heard loudest more to the left, and between the fifth and sixth ribs, it is the mitral valve. When, however, it is remembered that the valves of either orifice are contiguous, and in the same line, it will be plain that much difficulty must and does exist in determining the particular valve affected. Sometimes both valves are affected, and then we have a double "bruit."

When the orifices of the heart are so dilated, or the valves so bound down that they cease to close the orifice, a permanent patency, as it is termed, is established. If the defect of the closure be inconsiderable, this also causes a double bruit; the first taking place on the contraction of the ventricle, and the other on its relaxation, caused, as is supposed, by a *regurgitation*. If, on the contrary, the orifice be greatly enlarged, so that the column of blood rests on the ventricle, hardly any bruit is heard, and the incessant effort the heart is now obliged to make to free itself from the blood at length so enfeebles it that the pulse becomes a mere flutter, and the patient rapidly sinks. Again, if the orifice be a mere slit, the same absence of bruit has been observed, the powers of the heart being probably so reduced as to be only capable of exciting a force sufficient to furnish the quantity of blood equal to that discharged by the diseased orifice. As a general law, when the valves are diseased the intensity of the sound varies directly according to the size of the chambers, combined with the degree of the hypertrophy of their walls, the sound being loudest when increased size is united to increased power. As a general law, also, the intensity of the impulse varies directly according to the degree of hypertrophy of the walls.

Diagnosis.—The diagnosis of disease of the valves of the heart is sometimes difficult in slight cases, from our liability to confound the respiratory bruit with the valvular bruit; but a little attention and a repeated examination will remove this error. Another circumstance of difficulty in the diagnosis is, that when the valves are greatly diseased, and the heart rolling, the quantity of blood projected at each contraction is so small that no bruit is produced. Under these circumstances, the patient should be kept quiet for some minutes, when the circulation will become more tranquil and the bruit will return, and often be loudly heard. Position, also, as lying on the back, diminishes the intensity of the sound, the heart in this posture circulating the blood with less difficulty.

Prognosis.—In every case of diseased valves, the prognosis is unfavourable; indeed, hardly an instance is met with of perfect recovery. The patient, however, often survives many months, and even some years, if he can command the comforts of life without the necessity of personal exertion.

Treatment.—Endocarditis, from whatever cause, is one of the most intractable diseases we are at present acquainted with. A few patients do recover after the establishment of the bruit, but it is probable in these cases the bruit must be caused by some irregular muscular contraction of the heart, and not from actual disease of the valves. For when the valves are thickened, indurated, or united by inflammation, there is no authenticated case of the patient's being again restored to health. Such an obstacle consequently appears to be permanent; for neither mercury, nor the iodide of potash, nor any known metal, salt, or acid, purgative, emetic, or tonic remedy seems to have any power to remove it. It will be plain, also, if the obstacle be permanent, that bleeding to any amount will cause debility, and facilitate probably the occurrence of the more severe and fatal symptoms; and this operation should seldom be had recourse to, unless the patient suffers from a considerable hæmoptysis. It is difficult, since this affection is followed by asthma, dropsy, and so many different trains of disease, to lay down any given rules of treatment; but gamboge gr. ij. c. opii, gr. ſs. ter die, the seminum iberidis gr. iij. ter die, tinct. digitalis ♏ viij. to xij. ammonia, camphor mixture, and æther, and the bitartrate of potash are among the most efficient remedies we possess. These always palliate the symptoms; but an apparent cure is almost always shortly followed by a relapse.

The diet of the patient should be light but nutritious, and when these qualities are conjoined its particular nature is perhaps not important.

The diseases of the aorta and large arteries often play a great part in medicine; but as the diseases of the arteries must necessarily be treated of in surgery, we purposely omit them.

Order II.—Of Rheumatism.

Rheumatism is a peculiar inflammation of the fibrous tissues, especially of the muscles, tendons, aponeuroses, bursæ, capsular ligaments, cartilages, and bones. It differs from ordinary inflammations in its little tendency to ulceration, and also in its great tendency to metastasis, or to shift from part to part.

This disease derives its appellation from ρεω, to flow; it being the opinion of the old physiologists that the different humours of the body were first sublimed, then condensed in the brain, whence they flowed to different parts of the body, and when over the fibrous tissues they produced rheumatism; 1030 persons are said to have died of this affection in 1838, and 946 in 1839, in England and Wales.

Remote Causes. — There are few morbid poisons which do not produce pains which cannot be distinguished from rheumatism: thus typhus fever begins by pains in the bones and muscles, and often ends with severe pains in the legs. The paludal poison also often leaves severe hemicrania, or rheumatic affection of one side of the head. In small-pox the patient often suffers for several days from pains which have frequently been mistaken and treated for rheumatism. In scarlatina the joints are often the seat of the severest rheumatic inflammation; while in syphilis nothing is more common than for the patient to be long racked with what appear to be rheumatic pains. It is plain, therefore, that morbid poisons are a frequent cause of a condition of parts which cannot be distiuguished from rheumatism; and it is a question whether some undefined miasm of this class is not therefore by far its most frequent cause; again, if we look to the course of the disease, it differs from all ordinary inflammations in the tendency it has to subside in one part and to appear in another, phenomena explicable on the laws of morbid poisons, but which are opposed to all we know of the laws of ordinary inflammation. Supposing this view of the case should ultimately prove correct, it will follow that cold and wet, by lowering the vitality of parts, greatly assist in pointing to the particular seat of the action of the poison, but are not the great agents in the production of this disease.

Any more express investigation into the remote causes of rheumatism is extremely unsatisfactory. They are generally supposed to be identical with those causes which produce catarrh; still in all probability catarrh itself depends on a morbid poison. Those, however, who refer catarrh to the vicissitudes of temperature, attribute rheumatism to this cause; but the returns of rheumatism occurring in the different commands of our army seem to shake this hypothesis: they are as follows:—

	Jamaica.	Nova Scotia and New Brunswick.	Bermuda.	Malta.	Ionian Islands.	Gibraltar.	Canada.	Mauritius.	Windward and Leeward Command.	United Kingdom.	Cape of Good Hope.
Ratio per 1000 . . Annual mean strength	29	30	33	34	34½	38	40	46	49	50	57

"Thus," says Major Tulloch, "we find in the mild and equable climate of the Mediterranean or the Mauritius the proportion of rheumatic affections is even greater than in the inclement regions of Nova Scotia and Canada; and though some of the provinces of the Cape of Good Hope have occasionally been without rain for several years, yet rheumatism is more frequent in that command than in the West Indies, where the condition of the atmosphere is as remarkably the reverse." Exposure to wet, however, would appear to have much influence in the production of rheumatism, for we find the returns of the navy show a considerably larger proportionate number of attacks than in the army. The number per 1000 annual mean strength attacked in the Mediterranean fleet being 63·9, in the West India and North American station 69, and in the South American station 72·3.

Some writers have supposed that the cause of rheumatism lies not so much in the abstract degree of cold as in the range of atmospheric vicissitudes; and Dr. Haygarth has estimated that the number of persons attacked with rheumatism in summer is to those attacked in winter in the ratio of 5 to 7. But Hippocrates says, it is not in the heats of summer and depths of winter, when the variations of temperature may be supposed to be a maximum, but rather in the spring and autumn, when the weather is warm but variable, that rheumatism most frequently prevails.

Whatever may be the remote cause of rheumatism, Dr. Haygarth thinks it remains latent from 2 to 6 days, while Giannini extends the period to a fortnight. Chomel, however, conceives it may in some cases be brought into action in from 12 to 24 hours.

Predisposing Causes.—A very small number of children suffer from rheumatism; for out of 73 cases given by Chomel 2 only were attacked under 15 years—35 for the first time between 15 and 30—22 from 30 to 40—7 cases from 45 to 60—and 7 cases after 60. At whatever age, however, rheumatism occurs, one attack establishes a predisposition to another, so that at last many persons are never free from it but are martyrs to this affection. Men are supposed to be more liable than women to rheumatism, and Dr. Marlow says in the ratio 137 men to 89 women. After menstrua-

tion, however, has ceased this greater immunity terminates

Pathology.—The essential nature of rheumatism in its simplest state is a mere *neurosis*, the inflammatory state, though common, being consequently an occasional accident, for many patients have died after long suffering from rheumatism, and, having been carefully examined, not the slightest trace of inflammation has been discovered in the affected limb or joint. Whichever form of this affection takes place, it has a tendency, says Dr. Budd, which " repeats itself in the fellow limb, not merely with a general correspondence of situation, but joint for joint, bursa for bursa, sheath for sheath,"—shooting sometimes from part to part with the violence of a galvanic shock, and occasionally attacking two legs of the vital tripod, or the heart and brain.

The parts affected in rheumatism are so numerous, being ligaments, fascia, aponeurosis, periosteum, perichondrium, bones, muscles, tendons, bursæ, and the serous membranes of the heart and brain, that it is impossible, within the limits prescribed to us, to enter minutely into the pathology of rheumatism; all we can do is to state generally that these parts are liable in rheumatism to be the seat of diffuse, of serous, of adhesive, and sometimes of purulent as well as of ulcerative inflammation; and these inflammations may be acute or chronic, chromatous or achromatous.

When the patient has fallen from an attack of acute diffuse rheumatic inflammation, the muscles of the affected joint, or of the heart, have been found evidently injected, and of a deep venous red or black colour. Also, the synovial membranes, the pericardium, and the membranes of the brain, when those tissues have been affected, have likewise been found red and injected, thus affording abundant evidence of the existence of diffuse inflammation in acute rheumatism.

The diffuse inflammation may terminate by resolution, or serum may be effused. *Serous* inflammation is extremely common, and is evidenced by the swollen state of the bursæ and parts external to the joint, often by an evident fluctuation within the cavity of the joint; and should the patient fall, we often find the cavity of the arachnoid and of the pericardium loaded with serum, the latter often to the extent of many ounces.

Adhesive inflammation is one of the most frequent results of acute rheumatism. The cellular tissue surrounding the diseased articulation being not only found thickened, but also often infiltrated with a loose coagulable lymph. The tendinous sheaths and capsular ligaments also often offer the same alterations. After an indefinite time the effused lymph becomes organized, and in this manner parts are bound down and the motion of joints greatly and sometimes permanently impaired. The alterations of the synovial membrane are not the least curious of the changes which occur in rheumatic joints from adhesive inflammation, for this tissue is not only often thickened, but villous processes, like the papillæ of the tongue of herbivorous animals, only soft and red, and dipping into the depressions around the neck of the bone, are occasionally formed, which are not only intractable even to long treatment, but often render the amputation of the joint necessary. The strongest evidence of adhesive inflammation is, however, the immense effusion of lymph which often takes place in rheumatic pericarditis, sometimes covering the whole surface of the heart and pericardium with a layer of lymph half an inch in thickness, and whose irregular surface has been compared to a honeycomb, a calf's stomach, or to the rind of a pine-apple.

Suppurative inflammation is so rare a termination of even acute rheumatism that many writers have denied its existence altogether. Stoll, however, has noticed this termination, and many other physicians have observed the same fact sometimes in the muscles, but more commonly within the capsules of the joint. Of this last form of disease Chomel has seen three cases, Moreau one, Piorry two, and Cruveilhier three cases; and to these Bouillaud and Macleod have made several additions.

Ulcerative inflammation is by no means unusual, sometimes perforating the capsular membrane or destroying the ligaments, but more frequently eroding the cartilages and the ends of the bones.

The chronic forms of rheumatism are principally achromatous; and this is strongly seen in ulceration of the cartilages without the trace of a red vessel. Whilst the absorption of cartilage is going on, a remarkable change sometimes take place in the bones, which are sometimes enlarged, and almost eburnified from increased ossific deposit, causing not only a change of form in the articular extremity, but presenting a mechanical obstacle to the motion of the joint. When the hip-joint is affected, says Dr. Todd, the acetabulum becomes deeper and wider than natural, and the head of the femur flattened and expanded, assuming something of the shape of the turnip. In this diseased state the bones have been found by Dr. Macleod to contain urate of soda. Portal states also that he has found the bones so soft in rheumatism that they might be cut with a knife.

Symptoms.—Rheumatic inflammations may be acute or chronic, but the proportion of the latter is infinitely greater than of the former.

Acute rheumatism is a severe inflammation of the feet, or of the hands, or of the larger joints, as the wrist, ankle, knee, hip, elbow, and shoulder joint, or of one or more of these parts, and this is usually accompanied by a sharp inflammatory fever. These affections often constitute the whole disease; but in a given number of cases, either with or without the subsidence of the articular inflammation, the heart or pericardium, or else the membranes of the brain, become the seat of the rheumatic inflammation. The proportion of persons whose heart is thus affected probably varies according to the treatment. Bouillaud estimates the number at more than one-half, or as 64 in 114 cases, and Dr. Macleod at one-fifth; but even this latter calculation is probably in excess. The affection of the membranes of the brain is much more rare, so that the proportionate number is not determined.

In an attack of acute rheumatism the fever often precedes, by twenty-four or forty-eight hours, the inflammation of the joints; but this is not constant, for in some instances the local and general symptoms are contemporaneous, while in others the inflammation of the joints is established before the accession of the fever.

The fever which attends acute rheumatism is well marked and striking. The chilliness or shivering with which, in common with other acute fevers, it is ushered in, speedily passes away, and is followed by great heat of the skin, and by copious but partial perspiration,

almost invariably acid, reddening litmus paper, and of a disagreeable odour; the pulse rises to 90, 100, and 110, and is large, full, and strong; the tongue is greatly loaded with a white or yellowish-white mucus; the bowels sluggish; the evacuations dark and offensive; and the urine scanty, with a copious deposit of the lithates. There are many remarkable differences between this and ordinary fever, for it runs no given course, is not marked by changes of the tongue, nor by any great depressing action; while delirium and even headache are of rare occurrence.

The local symptoms which accompany the inflammation of the articulations are pain, heat, redness, and tumefaction. The *pain* is generally active and severe, although in a few cases it is latent,—that is, the patient is at ease, unless the joint or limb be moved. It has many degrees of intensity, being in a few instances trifling, but more commonly atrocious and agonizing, and though generally constant, it is sometimes intermittent. In all cases in which it exists, it is greatly augmented by pressure, so that the slightest touch—even the weight of the bed-clothes—is insupportable; and, by an inexplicable law, it usually somewhat remits during the day, and is aggravated at night. The *heat* of the inflamed joint is constantly increased, the thermometer indicating a temperature of 100, 105, or even more degrees. *Redness*, though not universally present, is nevertheless the rule of the disease, and the affected joint is surrounded by a rose-coloured flush, evanescent on the slightest pressure, yet returning on its removal. The *tumefaction* of the part caused by the effusion of serum into the synovial cavity, or into the cellular tissue and other parts surrounding the joint, is often great, generally indeed so considerable that the shape of the hand, the ankle, or other joint, is completely destroyed. In affections of the knee the patella is often more or less displaced, by effusion into the cavity of the joint; and this, together with the swelling of the external parts, renders it misshapen, rounded, and obliterates all the markings of its healthy state.

Such are the general and local affections in acute rheumatism, and at the height of the disorder it is difficult to conceive a more complete picture of helplessness and suffering than that to which they reduce the patient. A strong and powerful man, generally unused to disease, lies on his back motionless, unable to raise his hand to wipe the drops which fast flow from his brow, or the mucus which irritates his nostril. Indeed, he is so helpless, that he is not only obliged to be fed, but to be assisted at every operation of nature. The sweat in which he lies drenched brings him no relief; his position admits of no change; and if he sleeps, his sleep is short, and he wakes up with an exacerbation of suffering which renders him fretful, impatient, and discontented with all around him.

The duration of acute rheumatism is very various; in some cases both the fever and local pains are gone in three or four days, but in the majority of instances they continue till about the tenth to the fourteenth day, when the fever disappears and the pains begin to subside, and towards the close of the third week or the beginning of the fourth, the patient is recovered, and generally without injury to the joints affected. In almost all cases, however, the pain continues till after the fever is gone, and sometimes for a very long period afterwards. The patient, though recovered, is liable to relapse, and often suffers from it.

The symptoms which have been described, constitute the usual forms of acute rheumatism; but in a given number of cases this course is interrupted by the heart, the pericardium, or else the membranes of the brain becoming the seat of this severe affection.

About the middle period of an attack of acute rheumatism, and sometimes towards its close, the heart is often affected with rheumatism even when the original attack is not of the severest character. The symptoms which mark it are pains or soreness all over the chest, increased on pressing between the intercostal spaces, and also on taking a deep breath. The patient also is restless—his countenance anxious, and occasionally he coughs. On applying the stethescope to the chest, the bruit de soufflet is often heard loud and permanent, and evidently arising from some irregular contraction about the orifices of the heart, or else from some affection of the valves. Many pathologists, it has been stated, conceive we can determine the exact pathological state of the pericardium. Thus, if the inflammation be diffuse, we shall have a crackling sound, like that of new leather, the parts being dry; or if serum be effused, we shall find the heart moving in a larger space than usual. Again, if lymph be poured out, we shall have a rubbing sound; and lastly, if pus be poured out, it will be determined not only by the greater space in which the heart moves, but by the sudden collapse and rapid sinking of the patient.

The duration of this secondary affection is very various. If the disease be severe and neglected, the patient often dies in three or four days; under proper treatment it seldom continues beyond a week; but there are cases in which, either from relapse or other cause, it lasts for three weeks, or even a month, as in an instance now in St. Thomas's. If this attack be altogether neglected, and the patient survive, the pericardium either becomes adherent, or the valves of the heart become permanently diseased, and its ulterior effects are dropsies, asthma, or affections of the lungs, which baffle all the resources of our art, and consequently are among the most fatal maladies incident to humanity.

The rheumatic inflammation in a much smaller number of cases affects the membranes of the brain. In these cases the patient first complains of severe headache, and this is shortly followed by delirium, high fever, and rapid pulse, and in this state he may die in a few days, but more commonly he recovers. As the opportunities of examining those who have fallen from rheumatic metastasis to the head are few, it is perhaps our duty to give the results in three cases which occurred in the extensive practice of Dr. Watson. The first was a young woman, 17 years of age, who had acute rheumatism of the joints; afterwards a rheumatic metastasis to the chest, for which she was bled, when she became furiously maniacal and died. The vessels of the brain were fuller than usual, but its membranes were healthy. The pericardium was glued to the heart in several places, and where not adherent, was universally coated with a layer of rough reticulated lymph. In another case, a post-boy, aged 28, attacked with much fever, and rheumatic pains shifting from joint to joint, but without any swelling; a metastasis at length took place to the brain, when he rambled, refused his medicines, and after lying delirious for 10 days, he died. On examination the cerebral veins were gorged with blood; a considerable quantity of serous fluid was found beneath the arachnoid and

in the lateral ventricles, while the mitral valve was covered with a row of bead-like warts. The other two cases are not dissimilar. Dr. Watson, from a consideration of these cases, is inclined to infer that the delirium is not a metastasis of the rheumatic virus to the brain, but a symptom merely of pericarditis; but this hypothesis can hardly be maintained, pericarditis being often met without any delirium or affection of the brain, while rheumatic affection of the brain has been met with without the existence of any pericarditis. The pathological phenomena, however, of the first case may render it doubtful whether the virus had caused mere deranged function of the functions of the brain, or whether the substance of the brain, from the increased quantity of blood, was diffusedly inflamed.

Chronic Rheumatism is generally a strictly local disease, without fever or any considerable derangement of the health; and the symptoms, consequently, when it occurs in the joints, are limited almost entirely to pain and to the different appearances caused by the effusion into the internal or external parts of the joint. In many cases, however, as in affections of the hip or shoulder-joint, there is no swelling, and pain is often wanting, except when the part is put into action, or when the patient gets warm in bed. It has been shown that chronic rheumatism more often attacks two similar joints than one, giving a symmetrical character to the disease; and very commonly both hands, both wrists, or both knees are affected, and with identically the same lesion and deformity. The larger joints, however, are exceptions to this rule, for it is rare that more than one hip, one shoulder, or elbow-joint, is affected.

Besides the joints, the different muscles of the body, their fascia, or tendons, are often the seat of chronic rheumatism, and there are few structures of this kind that entirely escape. The scalp, for instance, is often affected. The muscles of the eye are occasionally so; Stoll quotes one case in which the woman squinted while the disease lasted. Rheumatism of the face is by no means unfrequent, and the muscles of the larynx are occasionally affected, causing aphonia. Everybody is familiar with the rheumatic affection termed "crick in the neck;" it also affects the articulations of the clavicle and the intercostal muscles. Rheumatism of the abdominal muscles is by no means rare, the principal pain being at their insertion into the crista of the ilium. Lumbago is well known as an affection of the lumbar muscles, extending often to the ligaments of the sacrum. The insertion of the tendo Achillis into the os calcis is another seat of rheumatism, but no parts are more often or more painfully affected than the tendinous structure of the soles of the feet. These forms of rheumatism are seldom accompanied by any swelling or other external symptom.

The pain in chronic rheumatism is often latent, unless the part be moved, and then the agony is severe. In many cases it is quiescent during the day, but is extremely acute during the night. This pain has a great tendency to shift from joint to joint, often subsiding and again recurring. Redness is rarely or never present in chronic rheumatism.

The lesions of motion vary from mere stiffness to an entire binding down of the joint. In this manner the hip and shoulder may be so firmly fixed, that the arm cannot be extended or the leg raised. The knee and elbow joints are generally semi-flexed, and cannot be straightened; while the fingers, if straightened, cannot be bent, or if bent cannot be straightened. When the joint is fixed, the muscles of the limb often become atrophied, sometimes partially so. In a case now in St. Thomas's, the flexors of one hand are so feeble, and the extensors so powerful, that the fingers are turned backwards; while, in the other hand, the muscles being in an opposite state, the fingers of the other hand are clenched, the nails almost growing like those of a Hindoo devotee into the palm. The duration of chronic rheumatism is extremely uncertain; it sometimes disappears in a few hours or in a few days, but it may last many weeks or months, or even years.

Chomel has attempted to give the relative frequency with which different parts of the body are attacked with chronic rheumatism, and out of ninety cases he found the muscles of the body were affected eleven times; one side three times; the upper limbs twelve times; the lower limbs twenty-two times; the trunk eleven times; the vertebral column nine times; and some part of the trunk or limbs twenty-two times.

Diagnosis.—The only disease with which acute rheumatism, when attended with swelling and redness, can be confounded, is, perhaps, erysipelas. Chronic rheumatism is also often of difficult diagnosis when it attacks the intercostal spaces, being often confounded with leucorrhœal pains, or affection of the chest. It may also be confounded with many neuralgic affections, as well as with pleuritic diseases of the bones.

Prognosis.—The number of deaths from acute rheumatism returned for England and Wales hardly exceeds one thousand; whence it is manifest that this disease is seldom fatal, and perhaps the number of unsuccessful cases hardly exceeds one or two per cent. But although this disease is rarely immediately fatal, yet a considerable number of persons ultimately fall from diseases of the heart, apparently resulting from the action of the rheumatic virus. A very few deaths occur from chronic rheumatism, so that the numbers that fall bear but a very small proportion to those that recover.

Treatment.—Acute rheumatism is manifestly a highly inflammatory disease, the parts being red and swollen, and the blood drawn presenting a more copious layer of 'buff' than most other diseases, the proportion of fibrin, according to Andral, amounting sometimes to nine or more; we can hardly feel surprised that bleeding has been largely had recourse to. But, although bleeding has been extensively adopted, the profession is much divided as to the advantage derived from the practice.

Sydenham attempted the cure of acute rheumatism by bleeding, and he took ten ounces of blood on the first day, as much on the second, and he bled a third time a day or two afterwards, and three or four days after this he bled a fourth time. This was the early practice of our great master, but some years later we find he bled less and purged more, observing that repeated bleeding was too debilitating. This, however, is not the fullest extent to which bleeding has been carried, for Sauvage says that at Montpellier they bled in his time thrice a day, and to a great amount, and the result of his experience was that nature was the best physician. Bouillaud is perhaps the only modern physician who has adopted the system pursued at Montpellier; for in cases of no great severity he recommends four pounds and a half of blood to be taken in twenty-four hours, while in graver cases he takes eight, nine, and ten pounds of blood within the week. The advantages of this mode

Elementary Principles of Medicine.

of practice, he affirms, are, that the disease does not become chronic, and that its duration is abridged from one to two weeks, the mean duration of his cases, reckoning from the time of their admission to the hospital being nineteen and a-half days. The objections to this practice are, first, that very little is gained as to time; again, that the loss of so large a quantity of blood is worse than the disease, for it would be felt by most persons all their lives; and lastly, that this mode of treatment appears to have caused in his practice an unusually large number of cases of carditis—a larger number, indeed, than has been witnessed by any other person in the profession.

Without entering upon the effects resulting from those who adopt a middle course, it may be stated that many practitioners in the present day hold that bleeding, while the inflammation is confined to the joints, neither shortens the disease nor renders it more bearable, and therefore, except in particular cases, they adopt a treatment almost exclusively by purgatives and opiates. The particular purgative perhaps is not of great moment, but at St. Thomas's Hospital, a drachm of the sulphate of magnesia, with ♏xv. of the tinct. hyoscyami, out of camphor mixture, every four or every six hours, has been found eminently efficient and a perfectly safe remedy. Its effects are to moderately purge the patient, and to assuage his pains, and about the tenth day, or shortly afterwards, all the symptoms abate; in the third week he is generally up, in the fourth week, he is for the most part well, and, except in a few cases, in which the articulations of the hand remain enlarged, and which are reduced by a few leeches, no bleeding need be had recourse to.

Under the purgative treatment, carditis and arachnitis are of rare occurrence, but in a very few cases they do occur, and the treatment is similar in both instances. Some blood, but not to a large amount, should be taken from the head in the one case, and from the chest in the other; this done, calomel should be given to affect the mouth, in doses of five grains, once or twice a day, or every six, or every four hours, according to the severity of the symptoms, and it almost uniformly happens that, when ptyalism is produced, the heart and the brain are immediately relieved. It is remarkable that mercury, although it appears the specific agent in rheumatic carditis or arachnitis, has no very marked beneficial effect in the purely articular forms of acute rheumatism, which is another analogy bringing this disease under the laws of morbid poisons.

There are a small number of feeble irritable patients, who suffer so severely from the pains of acute rheumatism that their minds wander, or they become hysterical; and in these cases small doses of opium, gr. ſs. to gr. j., every six hours, is the best treatment.

Antimony is a remedy which has been much praised in the treatment of acute rheumatism, and perfectly succeeds in a few cases, in moderate doses; more frequently perhaps it is given without any marked success. Bouillaud says, he has seen the antimonium potassio-tartarizatum given to the extent of 150 to 160 grains in ten days, but that its efficacy was not greater than in the ordinary mode of small doses, while it often disagreed and produced derangement of the digestive organs.

The treatment of chronic rheumatism varies, according to Dr. Macleod, as it assumes one of the five different forms he assigns to it, or according to the tissue it affects; but rheumatism scarcely admits of a strict analysis into tissues, and perhaps the more practical rule is, that the treatment varies according to the joint affected. If the shoulder-joint be the part diseased, potassii iodidi, gr. viij. out of camphor mixture, ter die is generally efficient, especially if assisted by a blister. The elbow-joint yields even with more certainty to the same treatment, and often without the blister. The wrist and small joints of the hand, yield to the neutral salts, as the sulphates of soda or magnesia; but, if very chronic and constitutional, perhaps more often to turpentine, as olei terebinthinæ, ♏ x. to ʒ j., ter die, or to grains x. of the Canadian balsam, three times a day.

If the hip-joint be affected, and the disease is very acute, it is best treated by the disulphate of quina, gr. v. 6^tis^ vel 4^tis^ horis; if this disorder be only slightly acute, the warm bath, with small doses of mercury, or of potassium iodidum, succeed best, and if these fail cupping and blisters may be recommended, but they do not often greatly relieve the patient. If the knee be affected, mercury, leeches, and poultices, or else cold lotions, are the best remedies; but this latter disease is often long protracted and of difficult cure, whatever means we may adopt. Of all the effects of chronic rheumatism, however, the affections of the ankle joint are the most intractable, and no treatment can be spoken of with confidence; but, take it altogether, the turpentines are the most successful remedies. In cases of lumbago, if the disease does not yield to purging, it very rarely resists cupping on the loins; and if that fails ℥ ſs. of sp. terebinthinæ twice a week may be tried.

There is one remedy possessed of great fame in the cure both of acute and chronic rheumatism,—or colchicum; and Dr. Macleod speaks of it almost as a specific in diseases of the capsular membrane. In many well-marked diseases of this class, however, it has eminently failed, and after an extensive trial, we conceive it has not been found more beneficial than the more simple purgatives, while to some constitutions it seems eminently pernicious.

In chronic rheumatism much local treatment has been employed, but hitherto without any very satisfactory result; the warm bath seldom affords relief. Dr. Gower introduced the practice of wrapping the patient up in oiled silk, and applying heat by means of a spirit lamp, but this treatment was attended with little success. At the present moment wrapping the affected part in cotton wool, and then wrapping it up in oiled silk, is practised, and it is supposed with more success; while, among non-professional practitioners, an extensive series of experiments of wrapping the patient up in a cold wet sheet, and applying heat by means of a feather bed, &c., is going on, but with a success still problematical.

The diet of the patient, in acute rheumatism, should be strictly limited to slops and light puddings, and even in many chronic cases it is desirable it should be confined for a short time to puddings and white fish.

Of Podagra (πους a foot, and αγρα seizure, arthritis from αρθρος a joint. Gout).

Gout is an inflammation affecting the same tissues as rheumatism, and is likewise marked by the same mobility from part to part, and has also the same want of tendency to ulceration. It differs from Rheumatism, however, in the disposition of the inflamed parts to deposit a singular substance, or the urate of soda, and

also in its tendency to affect the stomach, the alimentary canal, and the bladder, rather than the heart and head. The common appellation, gout, is derived from the French *goutte*, a drop, and springs from the same physiology as gave rise to the origin of the term rheumatism. 215 cases are said to have died of this disease in England and Wales in 1839.

Remote Cause.—Two theories have been imagined to explain the remote causes of gout. The one is, that it results from general causes, as atmospheric vicissitudes, errors in diet, &c., "podagra Bacchi Venerisque filia," is a received maxim, and, according to Sydenham, it occurs chiefly in those who have passed their lives in ease, voluptuousness, and high living. The other is suggested by Rostan, who, observing the many different limbs it simultaneously affects, its rapid transition from joint to joint, and its singular deposition of the urate of soda, concludes that there is something more in gout than mere simple inflammation occurring in a particular diathesis, and he hints at a specific cause, having probably its seat in the solids. Sydenham, it is well known, considered the cause to be a peccant state of the fluids.

Predisposing Causes.—A few children have been attacked with gout at the early age of seven years: it very rarely, however, occurs before puberty, but is seen in both sexes under 20. Many cases occur between 20 and 30, but the period of greatest liability is perhaps from 30 to 50. After this the chances of exemption increase with age, probably from the more temperate habits of advanced life. At whatever age, however, gout appears, every attack establishes a greater disposition to another. Women often suffer greatly from gout, but not in an equal degree with men.

It is generally supposed that gout is hereditary; and in many instances it is so, whether the party adopt the habits of intemperance of his ancestors, or whether he be abstemious in his mode of living. In some families it attacks only alternate generations, following the law of *atavism*. Sydenham sums up the predisposing causes by saying, that it destroys "more rich than poor, and more wise men than fools."

Pathology.—The theory of gout is similar to that of rheumatism; or the gouty virus may produce either *neurotic* pains or else *inflammation*, and in either of these forms has the same tendency to affect similar limbs and similar joints, and also to fly from one part to another with terrific violence. This erratic property of gout is so well known, that Gay has thus popularly described it:—

"Next gout appears, with limping pace,
Pleads how he shifts from place to place;
From head to foot how swift he flies,
And every joint and sinew plies;
Still working when he seems supprest,—
A most tenacious, stubborn guest."

When the gout assumes an inflammatory character, it produces all the forms of articular inflammation which have been described in rheumatism, and these inflammations attack nearly the same parts, as the bones, cartilages, synovial membranes, bursæ, ligaments, muscles, tendons, and aponeuroses. These inflammations have nothing to distinguish them from rheumatism, except the singular pathological phenomenon of a tendency to the deposition of the urate of soda, a discovery we owe to the late Dr. Wollaston.

It is not determined in what form of inflammation the urate of soda is most frequently deposited, but occasionally it appears to be nearly the sole secretion from the affected part, nothing being seen on the poultice but this salt in a more or less fluid state. It is equally secreted from the joints of the toes or fingers, and probably from all their different tissues. Portal gives a case in which the articulations of both hands presented deposits of urate of soda, both within the capsules of the joints, and externally among the ligaments, while the tendons of the extensor muscles of the fingers were almost destroyed. In the Hunterian Museum of Glasgow there is a finger from a gouty hand, with a joint opened and bent upon itself, showing not only a deposition of the salt, but an erosion of the cartilages; also another in which the joint is full of this peculiar secretion, and a third in which the joint is everywhere invested with it. In the Museum of St. Thomas's Hospital there is a specimen in which the femoral cartilage of the knee-joint is coated with it, as if smeared over with plaster of Paris; and another in which it is deposited on the ligaments of the extensors of the hand. Guibert gives a case in which the metatarsal articulation of the great toe was surrounded by urate of soda of a rose tint, and on the inside of the foot, in the cellular tissue, was an abscess containing urate of soda, making its way to the surface; on opening the joint the same substance was also found, and on cutting through the tendons, pieces of urate of soda were distinctly seen between the fibres. Simon gives an account of a gouty skeleton, of which the bones were so completely anchylosed that even the brazen skeleton dedicated to Hippocrates in the temple of Delphos could not have been more inflexible. The bones, also, affected with this disease have been found swollen, and sometimes so soft as to have been easily cut by the scalpel.

The urate of soda is deposited first in a white fluid state, like a mixture of chalk and water, and often in such quantities that a poultice, though applied several times a day, has been covered with it, and that for several days together. It afterwards hardens and forms what, from their colour and appearance, have been termed *chalk-stones*, often superficial and of considerable size, so that when the skin has ulcerated a patient has been said in one case to have scored his game of cribbage with his knuckle, and in another to have written on the table with the *chalk* penetrating through the ulcerated tips of his fingers.

The arteries are often found ossified in gouty persons, and especially the coronary arteries of the heart; bony matter also has been often found deposited on the valves, and around the orifices of the heart, and hence the tendency of gouty patients to apoplexy and to asthma. The appearances which exist when a patient has fallen from gout of the stomach, bladder, or intestinal canal, have not as yet been described.

Symptoms.—The symptoms of the gout vary according as it attacks the joints, the stomach, or the intestinal canal, but the proportionate frequency with which these different parts are attacked is not yet ascertained. It may be acute or chronic, and when the viscera are affected, it has been termed irregular, retrocedent, or misplaced. Sydenham was himself a great sufferer from this affection, and laboured under it for more than 34 years, and thus describes an acute attack or fit.

"It comes on a sudden towards the close of January or beginning of February, giving scarce any sign of its approach, except that the patient has been afflicted for some weeks before with a bad digestion, crudities of the

stomach, and much flatulency and heaviness, which gradually increase till at length the fit begins." "The patient goes to bed, and sleeps quietly till about two in the morning, when he is awakened by a pain, which usually seizes the great toe, but sometimes the heel, the calf of the leg, or the ankle. The pain resembles that of a dislocated bone, and is attended with a sensation as if water just warm were poured upon the membranes, and these symptoms are immediately succeeded by a chilliness, shivering, and slight fever. The chilliness and shivering abate in proportion as the pain increases, which is mild in the beginning, but gradually grows more violent every hour, and comes to its height towards evening, adapting itself to the numerous bones of the tarsus and metatarsus, the ligaments whereof it affects so as sometimes to resemble a tension or laceration of those ligaments, sometimes the gnawing of a dog, and sometimes a weight and coarctation or contraction of the membranes of the parts affected, which become so exquisitely painful as not to endure the weight of the clothes, nor the shaking of the room from a person walking quickly therein; and hence the night is not only passed in pain, but likewise with a restless removal of the part affected from one place to another, and a continual change of its posture. Nor does the perpetual restlessness of the whole body, which always accompanies the fit, especially in the beginning, fall short of the agitation of the gouty limb. Hence numberless fruitless endeavours are used to ease the pain by continually changing the situation of the body and the part affected, which notwithstanding abates not till two or three in the morning, that is, till after 24 hours from the first approach of the fit." "And being now in a breathing sweat he falls asleep, and upon waking finds the pain much abated, and the part affected to be swelled; whereas before only a remarkable swelling of the veins thereof appeared, as is usual in all gouty fits."

"The next day, or perhaps two or three days afterwards, the part affected will be somewhat pained, and the pain increase towards evening, and remit towards break of day;" and "what we call a fit of the gout is made up of a number of these small fits; at length the patient recovers, which, in strong constitutions and such as seldom have the gout, often happens in fourteen days, and in the aged, and in those who have frequent returns of the disease, in two months; but in such as are more debilitated either with age, or the long duration of the distemper, it does not go off till summer advances."

In aggravated cases it attacks both feet, the hands, wrists, elbows, knees, and other parts; sometimes bending the fingers crooked and motionless, and at length "form stony concretions in the ligaments of the joints, which destroying both the scarf-skin and the skin of the joints, stones not unlike chalk, or crabs' eyes, come in sight, and may be picked out with a needle. Sometimes the morbific matter is thrown upon the elbows, and occasions a whitish swelling almost as big as an egg."

"During the first fourteen days the urine is high coloured, and after separation lets fall a kind of red gravelly sediment, and not above a third part of the fluids taken is voided by urine, and the body is generally constipated during this time. The fit is accompanied throughout with loss of appetite and chilliness of the whole body towards the evening." When the fit is going off a violent itching seizes the foot, especially between the toes, and the skin peels off as if the patient had taken poison.

When the disease has become chronic, or, as Sydenham terms it, inveterate, "after yawning, especially in the morning, the ligaments of the bones of the metatarsus are violently stretched, and seem to be squeezed with great force with a strong hand. And sometimes, though no yawning has preceded, when the patient has disposed himself to sleep, he feels a blow on a sudden as if the metatarsus were breaking in pieces by a large stick, so that he wakes crying out with pain. The tendons of the muscles of the tibiæ are sometimes seized with so sharp and violent a convulsion or cramp, that if the pain it occasions were to last only a short time, it could not be borne with patience."

After many racking pains, the following paroxysms become less painful, when, "instead of the usual external pain, a certain sickness, a pain in the belly, a spontaneous lassitude, and sometimes a tendency to diarrhœa succeeds." Besides the pain and sickness, the patient becomes lame and almost incapable of motion, and, like the late Sir Joseph Banks, is perhaps obliged to be wheeled or carried from room to room. The patient is not only reduced to this helpless condition, but, to complete his misery, his mind sympathizes with his body." "For every paroxysm may be justly termed a fit of anger, the rational faculties being so enervated by the weakness of the body as to be disordered on every trifling occasion, whence the patient becomes as troublesome to others as he is to himself.

Another form of chronic gout is *atonic gout*, or when the joints enlarge and the tissues and ligaments become thickened, and the seat of various effusions, so as often to distend and even to dislocate the bones, and yet if the patient be kept quiet he suffers no pain. The general symptoms, however, are most distressing, the patient suffering from loss of appetite, indigestion, sickness, nausea, flatulence, acid eructations, pains of the stomach, cramps in the legs, and in various parts of the body; also great dejection of spirits, vertigo, palpitation, fainting, asthma, and perhaps from stone or gravel, and these perhaps continue with occasional intervals during the remaining life of the patient, who is satisfied he has the gout *flying* about him, and that he should be well if he had a regular fit.

In the course of this disease there may be a metastasis to the stomach or other part, and the affection is now termed *retrocedent* gout, the pain in the joints being trifling, or having entirely subsided. When the metastasis is to the stomach or intestines, it may be either of a spasmodic or inflammatory character. The spasmodic is the most frequent, and in this case the patient is seized with violent pains in the stomach, with great faintness, coldness of the extremities, and a quick, small, and scarcely perceptible pulse, accompanied with much flatulence, acidity, or vomiting. If, on the contrary, the attack be of an inflammatory character, the pain is perhaps equally great, but is in creased on pressure, and there is more re-action, some fever, a fuller pulse, with vomiting, and perhaps obstinate constipation. The duration of these attacks is short, as the patient must be quickly relieved, or quickly perish. Besides metastasis to the stomach and intestines, this retrocedence may take place to other parts, as to the testicle, bladder, rectum, or to the head, and in the latter case the patient may die apoplectic. The transition of the gouty virus is often marked by a pain shooting along the nerve as sudden and as rapid as a galvanic shock, and so violent as to have been compared

to stabbing with a knife. Gout also, besides being transferred from part to part, often alternates with asthma, so that when the patient is free from the one disease he labours under the other.

But the miseries of the gout do not end here; for Sydenham says, " I made bloody urine, and did so whenever I walked much, or was carried in a coach over the stones, though the horses went slowly. The urine I voided on these occasions, though it looked very bad at the time of making, so as to resemble pure blood, yet soon after it became clear at the top like natural urine, the blood falling to the bottom by itself in clots." A description which renders it probable that his urine was loaded not only with blood, but also with uric acid.

Diagnosis.—The diagnosis between gout and rheumatism is often exceedingly difficult, so much so that nosologists have given a mixed class, or rheumatic gout. Mr. Hunter warmly opposed this compound appellation, for in his opinion no two distinct diseases, or even distinct diatheses, can co-exist in the same constitution; a law, it must be admitted, to have many exceptions.

Prognosis.—Every assurance office objects to a gouty person as liable to a disease indicative of excessive indulgence in the pleasures of the table; or at least to a disease tending to shorten life, from the wear and tear it occasions of the constitution; and the objection is unquestionably founded; for although a few persons may reach advanced age notwithstanding its repeated attacks, yet many fall prematurely from this affection, or from the asthma, affection of the heart, apoplexy, or from the accidents that helplessness and debility render the patient liable to.

Treatment.—The gout consisting essentially in inflammation of the joints and their surrounding tissues, it might be supposed that this disease would be best treated by bleeding, and blood has been drawn to a considerable extent, but without any corresponding benefit. " Bleeding," says Sydenham, " is not to be used either by way of preventing an approaching or easing a present fit, especially in the aged, for, though the blood that is taken away resembles pleuritic or rheumatic blood, yet bleeding is found to do as much mischief in this as it does good in those;" " and bleeding in the interval, though long after the paroxysm, is found to occasion a fresh fit." The experience of Barthez, of Guibert, and Hallé entirely coincides with that of Sydenham, for however freely employed (and in some instances 70 ounces have been taken away in a few days), they say bleeding does not afford that relief to to the local pain and inflammation which might have been expected, while the restlessness, debility, and mental depression, are often rendered truly distressing. In the present day bleeding is generally restricted to two cases,—or leeches to the part where the inflammation rises so high, or is so chronic, as to threaten the patient with the permanent loss of the use of some joint; and also to cases of inflammatory metastasis to the stomach or other internal organ, when leeches are absolutely necessary.

Sydenham was as great an enemy to purging as he was to bleeding; and he says, " I am abundantly convinced, from much experience, that purging either with mild or strong cathartics, whether it be used during the fit, or in its declension, or in a perfect intermission, or healthy state," " endangers the life of the patient by hurrying on to the viscera, which were quite safe before." The objection taken by Sydenham to purgatives lies certainly against those in use in his day, and which were of the most drastic kind. But it may be laid down as a rule that the class of neutral salts are not only safe, but efficient in relieving, though perhaps not of curing, gout. The theory on which they are prescribed is, that the alkaline base of the neutral salt is absorbed, and combines with the insoluble urates deposited in the joints, forming a soluble sub-urate, which can readily be absorbed; and again, more alkali being sent to the kidney, that organ is now enabled to remove more uric acid, in a soluble state, from the system than under ordinary circumstances. The salts the most in use are the sulphates of magnesia or of soda, and especially the former, and half a drachm to a drachm should be given every eight, six, or four hours, according to the state of the bowels, and the acuteness of the symptoms. It is also necessary to give some relief to the patient from his excessive suffering, and an opiate should be added, as the tinct. of hyoscyami, syrup of poppies, or some preparation of opium. This method relieves the patient and shortens the paroxysm; but when the relief is complete it should be abandoned, for sometimes the gout will return even under its use.

Colchicum or meadow-saffron was introduced as a specific in gout; and the "eau médicinale," as long as it was a novelty, and acted upon the imagination, occasionally shortened or removed the paroxysm as by a charm. A more widely-extended experience, however, has shown it to have little influence over the disease while in some instances it has been followed by most alarming consequences, acting upon the stomach and bowels with all the virulence of an active poison. It is still however used, and is valuable for its purgative qualities, although not for its specific effects, and may be given as an extract or tincture, or as a wine combined with some form of saline draught.

Mercury, from its power of absorbing many periosteal nodes, has been often employed with a view of removing the deposits of urate of soda, or the chalk-stones; but experience has shown this to be dangerous practice, for, if pushed to any extent, not only have the chalk-stones not been removed, but in two cases the patient has appeared to have fallen in consequence.

If acute gout should have retroceded, and the stomach or intestinal canal be inflamed, leeches should be applied to the abdomen or epigastrium, followed by a poultice, while the internal remedies should be the neutral salts with the tinct. hyoscyami 6^{tis} vel 4^{tis}, and it is very rare that more active medicines are necessary.

In chronic gout the treatment by saline purgatives and opiates is the same; but in *atonic* gout some light tonic medicine may be added, as 5 to 10 grains of the citrate of iron, or a drachm of the tinct. aurantii, and the menstruum may be the aqua menthæ pip. or the infusum aurantii comp. A large number of these cases, however, though the general health is improved by this treatment, are often altogether unrelieved, as to the local symptoms, and are often quite unable to assist themselves. In these instances the turpentines appear to be beneficial, as spruce beer, or the Canadian balsam, gr. v. to x. ter die, or the olei terebinthinæ ʒ j. out of an effervescing draught once or twice a day. Sydenham's method, or by manna, may also be tried.

If the chronic or *atonic* gout should become retrocedent, and the stomach and intestinal canal be the seat of the spasmodic form of the disease, Sydenham strongly recommends laudanum should be exhibited;

but perhaps the following draught is more efficacious: mist. camphoræ ʒ x., sp. ætheris sulphurici comp. ʒ j., confectio opiata ʒ fs., tinct. cardamomii ʒ j., and perhaps half a drachm of the sulphate of magnesia, to remove from the stomach any undigested matter which may remain as an irritating cause. This should be given every hour till the patient is relieved; and while it is being prepared, hot brandy and water should be freely administered, and hot cloths applied to the abdomen, as well as hot bottles to the feet.

Sydenham recommends, from experience in his own case, large doses of manna in all cases of what he terms "bloody urine."

With respect to any local treatment during the fit, Sydenham says, "if outward applications be inquired after to ease the pain of the gout, I know of none, though I have tried abundance both on myself and others, and I have laid aside the use of topics for many years." It is generally admitted that cold is dangerous, while warmth is productive of little relief. In some instances the urate of soda is deposited in such abundance that the skin ulcerates, and the salt is discharged in considerable abundance in a fluid state. It might appear the right practice to apply a poultice and encourage the discharge, in order that by its entire removal the joint might be saved. This, however, is very dangerous practice, for the discharge is so debilitating that two patients appeared to have died from this mode of treatment. It is much safer to wait till the chalk-stone is concreted, and then operate for its removal. With respect to the use of cold water, the practice is as old as Harvey, and subsequently it has been adopted and abandoned by many practitioners. Dr. Parry had at one time two cases who had attempted to cut short the fit by plunging their feet in cold water. The relief was instant, but in a few hours both were dead of apoplexy. The recent fatal result of this remedy in Sir Francis Burdett's case will not soon be forgotten.

As diet appears to have a great influence in the production of gout, so we should imagine it should have great influence in its removal; and, during the fit, it should be slops and light puddings, and afterwards white fish, till the paroxysm has terminated. This disease is so distressing that many persons are inclined severely to diet themselves during the interval. Sydenham says that a milk diet, or drinking milk as it comes from the cow, or boiled without adding anything to it, except perhaps a piece of bread once a day, had been much used for twenty years past in his time, and done much service in abundance of gouty patients. But on quitting it and returning to the mildest and tenderest diet of other persons the gout has immediately revived; and he adds, many cannot bear this regimen. An entirely water regimen he considers hurtful. His recommendations are, that we should be early to bed, keep the mind free from all disquietude, live with the greatest moderation, clothe ourselves warm, and ride on horseback. One other point with regard to treating the patient during the fit, is, if it be necessary to move him either on account of his restlessness or other cause, that this be done with great care and tenderness by the attendants; for although the pain may be latent while the parts are quiet, yet the least shock often causes the most excruciating agony.

The irritable state of mind of the patient during the paroxysm has been mentioned; and it is well known that slight moral causes will often produce a fit, while powerful emotions have sometimes cured one. There are many instances of persons confined to their beds with gout starting up and running away on an alarm of "fire" being raised. Dr. Rush gives the case of an old person whose son by some accident drove the shaft of his waggon through the window of the room where he was lying, when, forgetting his crutches, he leapt out of bed, and was found by his wife angrily walking up and down the room.

It is quite essential, therefore, the minds of gouty patients should be kept as tranquil as possible.

Order III.—Of Tuberculoma.—(*Tuberculum*, a small tumor. Scrofula.)

Tuberculoma is a peculiar morbid substance or growth infesting every organ and tissue of the body, and more especially the lungs, causing phthisis or consumption; but, wherever found, it follows, with little exception, the same laws in its development, course, and fatal termination. After inflammation this is the most important of the elementary forms of disease, both from the great number of persons it affects, as well as from its destructive tendency; for it is probable that every fourth or fifth death in England and Wales takes place from this disease having formed in some one or other organ or tissue of the body. Tuberculoma of the lungs, or phthisis, the more leading disease of this class, was unquestionably known to Hippocrates; but the laws of this substance, and the changes it undergoes, appear to have been first determined by Cruikshanks in 1790, and his opinions have been adopted and extended by Laënnec and Louis, so as to be generally received by most pathologists of the present day.

Remote Causes.—There is hardly any subject more interesting in medicine than the remote causes of tuberculoma. The broadest fact already established on this point is, that the domesticated animal is more liable to tubercular disease than the same animal in a wild state. The stabled cow, the penned sheep, the tame rabbit, the monkey, the caged lion, tiger, or elephant, are almost invariably cut off by tubercular affections. In man the same law appears to prevail, or in proportion as his habits of life are artificial so is his tendency to tubercular disease. This is strongly seen in the mining districts of Cornwall and Devonshire: for although those counties are considered among the most healthy portions of Great Britain, yet one-half of the whole number of the miners deprived of air and light die of phthisis. The Reports of the Registrar-General also show that, comparing the deaths from phthisis among the agriculturists and among the inhabitants of towns, the latter die in an increased ratio of 24 per cent. over the former; yet it is generally supposed that the dietary and general comforts of the townsman are greater than those of the countryman. Among the townsmen also it is determined that there are certain classes of men more predisposed to phthisis than others, as those workmen who suffer great vicissitudes of temperature, or who breathe an air loaded with particles of dust: as bakers, needle-grinders, gun-flint makers, cotton and wool carders, and bricklayers' labourers, and in this class of persons the disease has acquired the epithet of the "grinder's rot." It would appear also, from the great numbers that fall in the Foot Guards,

Elementary Principles of Medicine.

compared with the population generally, that the night air must be greatly injurious. A more minute analysis of the numbers that die of phthisis in the different ranks and classes of life is greatly to be desired in illustration of the remote causes of phthisis. The late Professor Coleman was of opinion, that by confining the horse in a dark and dirty stable, and by feeding him on bad provender and neglecting to clean him, he could produce phthisis in that animal at will; and similar causes will probably be found to produce similar results in man. When, however, we consider how many persons there are who carry cleanliness to excess, whose diet is most studied, and whose every exercise is directed to health, and who nevertheless die of phthisis, it is plain that some more secret and hidden circumstance still remains to be discovered to account for the existence of tubercular disease in this country.

It has been supposed that the tendency to tubercular disease was limited by latitude,—that it never appeared to the south of the Mediterranean, and consequently that it must have a local origin. But this does not appear to be the case, for the returns of the army have shown, to the astonishment of everybody, that phthisis is more frequent in the West Indies than even in this country.

Mortality by Phthisis Pulmonalis per 1000 White Troops.	Windward and Leeward Command.	Jamaica.	Gibraltar	Malta.	Ionian Islands.	Bermuda.	Canada.	Nova Scotia and New Brunswick.	Cape of Good Hope District.	Dragoon Guards, and Dragoons serving at Home.	Civil life in England and Wales, according to Registrar-General's Report.	Naval Force, Mediterranean.
	12	13	$6\frac{5}{10}$	6	5	$8\frac{9}{10}$	$6\frac{5}{10}$	7	$5\frac{5}{10}$	$5\frac{5}{10}$	4	

It would appear, then, from these tables, that England and Wales were more exempt from phthisis than many countries which, from their higher temperature, have hitherto been supposed to enjoy a remarkable exemption from this complaint. Another unlooked-for result from these tables is the entire refutation of the hypothesis that paludal districts are in an eminent degree exempted from phthisis; since England and Wales, the Cape of Good Hope, Canada, and Malta, countries either the driest or the best drained, and consequently suffering the least from paludal diseases, are actually those countries the most free from phthisis. Another general deduction of the influence of climate is, that phthisis is most frequent in low and damp situations; while it is far less so in the mountainous districts of all countries. Again, in whatever climate the disease breaks out, it is the opinion of many pathologists that its course is most rapid if the patient remains in that country; thus the late Dr. Hennen's experience convinced him, that when the disease broke out among our troops on the shores of the Mediterranean, that no other chance remained of prolonging the patient's life than by sending him at once back to this country. It must be admitted, however, that this law is anything but proved.

To those who consider variations of temperature, and the vicissitudes of the weather generally, as the great causes of phthisis, it will appear remarkable that the number of deaths in each season from this disease is nearly equal. Thus, according to the Registrar-General's Report for the year 1839, of 21,827 deaths from phthisis 5600 took place in winter, 5778 in spring, 5501 in summer, and 5148 in autumn. The influence of temperature, however, over the disease, according to the idiosyncrasy of the patient, is remarkable: for many survive as long as the weather continues warm, and die as soon as it changes to cold, while others suffer only slightly as long as the weather is cold, but perish as soon as it becomes warm.

It being impossible to connect phthisis in the present state of medicine with any given cause, or series of causes, another mode of viewing it presents itself; and that is, looking to the peculiar course many cases of phthisis run, the consecutive diseases it sets up, as fatty liver and ulceration of the intestines,—diseases certainly not a consequence of mere debility,—whether it may not result from the action of a morbid poison, rather than from any combination of general causes? The most general conclusion perhaps we can come to is, that the agent, whatever it may be, is a depressant of vital action; and that whatever tends to lower the system, as profuse evacuations, excessive depletion, scanty diet, insufficient clothing, unhealthful situations, or depressing passions, may become the predisposing cause of this disease.

Predisposing Causes.—The tendency to the formation of tubercle is not equally great in all parts of the body, nor at all periods of life. Tubercle of the brain, the bones, and of the mesentery, is most common in infancy, childhood, and early adolescence. But tubercles of the lungs, which form so large a portion of all these affections, although they have been found in the fœtus, and at every period of life up to 80, yet it will be seen by the following tables from Bayle and Louis that it is most frequent between the ages of 20 and 40; or there died from phthisis from

Years of Age.	Bayle.	Louis.	Total.
15 to 20 . . .	10	11	21
20 to 30 . . .	23	39	62
30 to 40 . . .	23	33	56
40 to 50 . . .	21	23	44
50 to 60 . . .	15	12	27
60 to 70 . . .	8	5	13
	100	123	223

Of ages younger than 15 there died of this "canker of the bud," according to Papaltoinc, out of 408 children,

Age.	Died.	Age.	Died.
At 2 years or less	72	At 9 years .	16
3 . . .	64	10 . . .	18
4 . . .	46	11 . . .	12
5 . . .	35	12 . . .	24
6 . . .	32	13 . . .	16
7 . . .	29	14 . . .	11
8 . . .	24	Age not noted .	14
			413

Sex has some influence in the production of phthisis, but not to any great extent, for out of 118,584 cases that died in England and Wales in 1838-1839 of that disease, 56,041 were males, and 62,543 females.

Of either sex *form* appears to give a marked predisposition to phthisis, the narrow-chested high-shouldered person being much more commonly its victim than those possessed of a more broad and capacious chest. Still the best formed persons often fall from it. The softer tissues also give many indications of a tendency to this disease; and most physicians are agreed that a soft flaccid habit of body—a remarkable clearness of complexion and softness of the skin—an eye of unusual pearly lustre—the senses and mental powers unusually acute—and a tumid upper lip, are all threatening marks of liability to this class of disease. If form gives a predisposition to phthisis, we can hardly feel surprised, as form descends, that tuberculoma should be popularly considered to be *hereditary* and to run in families. Louis, however, affirms, that in one-tenth only was he able to trace any parental taint of the disease.

With respect to *social* position, it is well ascertained, and on an extensive scale, that although the upper classes often suffer from phthisis, as the "fairest apple hangs on the highest bough;" still that the probability of life is greatly reduced from a tendency to tubercular diseases (especially among the children) in the lower classes resident in towns, who die, according to Dr. Alison, in Scotch towns, in the enormous disproportion of 45 or 50 to 5 and even 3, as compared with the agriculturists and upper classes.

Race has an influence in the production of phthisis. In this country the tendency of the Creole and Negro to phthisis is notorious. Even in the West Indies the black races are by no means exempt from this disease, and according to Mr. Rufz, the Creoles are remarkable for dying of it in large numbers in Martinique. This is the more unlooked for because as children they live almost in the open air, bathe daily, or still more frequently, and are singularly cleanly in their persons. He remarks also that the women of Martinique suffer in a large proportion, and yet the use of corsets is unknown among them.

Among the predisposing causes, says Laënnec, of phthisis, I know of none more certain than the *depressing passions*, especially when they are profound and long indulged; and this perhaps is the cause of the greater prevalence of this disease in larger towns, where bad habits and bad conduct are more common, and often the cause of those bitter regrets which neither time nor consolation can assuage. He adds, I had under my own eyes for ten years a most striking example of the influence of melancholy in the production of phthisis. There existed in Paris for that space of time a nunnery of a new foundation, and which had not been able to obtain from the ecclesiastical authorities anything but a temporary tolerance on account of the severity of its rules. Their alimentary regimen, although extremely severe, was still not beyond the powers of nature; but the spirit of their rules directing their minds to the most terrible truths of religion, as well as compelling them to resign themselves in everything to the will of the abbess, produced effects as sad as unexpected. These effects were the same in all. At the end of two months' sojourn in this house their menses were suppressed, and in a month or two afterwards symptoms of phthisis appeared. As they had not been allowed to take the usual vows, I intreated, as soon as this was the case, that they would leave the house, and all who followed this advice recovered. But during the ten years I was physician to this establishment, the members were renewed twice or thrice, with the exception of the superior, the tourière, the sisters who had the care of the garden, of the kitchen, and of the infirmary, or of such as had more frequent intercourse with the city, and consequently greater distraction. The rest died of phthisis.

Pathology.—Mr. Cruikshanks, in the year 1790, affirmed that tubercular matter had three stages, or that when first deposited in the lung it is a grey semi-transparent substance; that in a subsequent stage it becomes yellow, opaque, and hard, like particles of cheese; while, in a third stage, it melts down into common pus. These three stages are very generally received as marking the progress of tubercle, and its more detailed laws are as follow.

Tubercular matter, when first deposited, is a grey, semi-transparent, gelatiniform fluid—the fluid particles of which, after an uncertain time, are absorbed, so that the gelatiniform matter becomes hardened. It may be deposited in a variety of forms; that is, it may be granular or in large masses, or it may be infiltrated in an amorphous state into the loose substance of the lung, or deposited in a loose state at the free surface of a serous or mucous membrane. In the lungs, the granular form is the most frequent; and in this state the following changes may be plainly demonstrated. The gelatiniform granules are of a spherical shape, about the size of small shot, and often in such prodigious numbers that the broken or torn surface of the lung has a granular appearance, and hence they have been termed miliary granulations. The duration of this first gelatiniform stage is not determined, but after an uncertain period, as a few days, a few weeks, or a few months, a small opaque yellowish white spot is seen in the centre of each granule, and this increases from the centre to the circumference, till the whole granule is converted into an uniform opaque yellowish white matter of the consistence of cheese, and this is the form in which tubercular matter is most frequently met with, and is termed "crude tubercle."

The crude tubercle has been analyzed by Thenard, who determined it to consist of animal matter 98 parts, and of carbonate of lime, muriate of soda, and phosphate of lime, with a trace of oxyde of iron 1·85. But these proportions appear greatly to vary; for a tubercle having a cretaceous character consisted of animal matter only three parts, and of saline or cretaceous matter 96 parts. When viewed under a powerful microscope, crude tubercular matter has elementary forms which distinguish it from every other substance, and is thus described by Lebut. It consists of molecular oval or circular glo-

bules, which vary from $\frac{1}{600}$ to $\frac{1}{400}$ of a Paris line in diameter, and are consequently much smaller than the blood globules. These are united by a transparent cellular tissue, forming cells, which, as the disease advances, disappears, and is supposed to have become atrophied. There are, besides, a number of angular corpuscles, $\frac{1}{100}$ to $\frac{1}{150}$ of a millimetre, irregular in form, and often containing a number of granules in their substance, which is yellow, opaline, and striated. It is these corpuscles which give to yellow tuberculoma its peculiar character.

The duration of the stage of crude tubercle is uncertain, but at length a third and last stage forms, marked by another vital process commencing in the centre of the granulation, by which the tubercular matter is softened and converted into pus, and from the centre this process extends to the circumference, till the whole tubercle is converted into pus. The tuberculous matter being thus liquified, ulceration of the surrounding tissues takes place, and the pus escapes as from an abscess.

The duration of the different stages of granular tubercle, it has been stated, is very various. It seems probable, from the short interval which elapses in some cases from the perfect health of the patient till his death from phthisis, that the whole duration of the disease hardly exceeds a month. In other cases, however, it is probable that each stage may last many weeks, or months, or years. Indeed, some patients appear to be dying of phthisis during a long life. As the granulations are frequently met with in every stage in the same lung, it is probable that the tubercular matter is often deposited in a succession of crops. Such are the laws of granular tubercle, as established by Cruikshanks. It must be admitted, however, that these laws, though generally are not universally received; for many pathologists, with Andral at their head, conceive that tubercle is always deposited in a crude state, and consequently that the grey gelatiniform matter and tubercle are distinct diseases. They admit that tubercular matter is often found within the gelatiniform matter, but esteem this an accident, the latter disease having supervened on the former. They admit also the central suppuration of the tubercle, but consider it to be caused by its including a portion of living cellular tissue, which takes on a suppurative action. Another circumstance, also, which has divided pathologists, is, whether tubercle is the result of inflammatory action. It is certain, however, that the tissues immediately surrounding both the granular and crude tubercle are often perfectly healthy in appearance, and that no redness or other vestige of disease is visible. It follows, therefore, if tubercle be a result of inflammation, it must be strictly of an achromatous character.

When tubercular matter is deposited in large round masses, it follows the same laws and course as granular tubercle. When, however, it is *infiltrated* into the substance of the lung, its changes are similar, but not so definite; for although the conversion of the gelatiniform mass into crude tubercle, and of crude tubercle into pus, begin in the interior of the infiltrated mass, yet these processes may be more or less superficial, and originate at any given point. Also, when deposited at the free surface of a serous membrane, it is generally found in a crude state, and so loosely attached that it may readily be wiped off; and whether it undergoes in this state any further conversion is undetermined. It is apprehended, however, that the vital changes which have been demonstrated taking place in the granular and larger formed masses distinctly prove this substance to be a living part, and subject to the laws of life. Some authorities have endeavoured to account for these changes by supposing some loose cellular tissue has become incorporated in the tubercular matter, and given rise to the changes in question; but this hypothesis hardly alters the case, as it still shows a living principle essentially connected with the tubercle. We shall now proceed to offer a few short remarks on the seat, size, and forms of tubercle.

When tubercular matter is deposited in definite masses, their *form* is round or ovoid; and as these forms are constant, it is evident this characteristic of their nature is not accidental, and almost demonstrates that it is first deposited in a fluid state.

The *size* of the tubercle is very various, or from a small granule to a hen's egg. In general, however, they vary in magnitude according to the organs in which they are situated. In the lungs they are seldom bigger than a swan-shot, although they have been met with as big as a pea, or even a hen's egg. In the spleen, they vary from a small shot to a large bean; while in the liver they are seldom less than an olive, and often as big as an orange. It is in the cervical, axillary, and inguinal regions, and also in the folds of the mesentery and mediastinum, that, according to Lugol, they attain their largest size, being often in these parts as large as an apricot, and sometimes greatly exceeding a large egg. These large tubercular masses, Lugol conceives, are often constituted of two or more tubercular tumors united; a formation sometimes rendered evident by incising the tumors, when we find the divisions distinctly marked.

Most pathologists conceive that the round tubercle is, for the most part, non-encysted—so much so that Louis states that he has only met with one case of encysted tubercle; but Lugol affirms that they are generally covered with an envelope.

The *seat* of tubercle is perhaps every tissue of the body; but, as a general rule, it has a decided predilection for cellular tissue. Dr. Carswell is of opinion, when the mucous system constitutes a part of the organ affected, that system is its principal seat.

The deposition of tubercular matter appears to be the result of a constitutional taint; for when a limb has been amputated in consequence of a scrofulous joint, the disease has, in general, broken out in some other joint or part. Again, notwithstanding the many phthisical bodies that are examined, and the many accidents incident to the examination, no instance is known of tuberculoma having been contagious. Tubercular matter likewise is not deposited with an equal frequency in all organs; neither are those organs which are the most frequent seat of tuberculoma in the child those organs in which it is most frequently found in the adult. Thus, out of 100 cases of tuberculated children, and 100 tuberculated cases of adults, M. Lombard found tubercles—

	Children.	Adults.
In the Lungs	73 times	100 times
Bronchial ganglia . .	37	9
Mesenteric ganglia . .	31	19
Spleen	25	6
Kidneys	11	0
Intestines. . . .	9	26
Nervous centres . . .	9	4
Cervical ganglia . . .	7	7

	Children.	Adults.
In the Meninges of the brain	6	2
Pancreas	5	0
Gastro-hepatic ganglia	5	0
Sub-peritoneal tissue	5	4
Inguinal glands	3	0
Sub-pleural cellular tissue	2	0
Lumbar ganglia	1	4
Sub-mucous tissue of urinary bladder	1	1
Epiploon	1	1
Walls of the gall-bladder	1	1
False membrane of the pleura	1	2
Axillary ganglia	0	3
Ganglia of the anterior mediastinum	0	3
False membrane of the peritoneum	0	2
Intercostal muscles	0	2
Ovaries	0	2
Liver	0	1
Cavity of the pleura	0	1
Anterior mediastinum	0	1
Vertebræ	0	1
Ribs	0	1
Uterus	0	1
Prostate	0	1

Thus, it will be seen that tubercles of the spleen occurred in $\frac{1}{4}$th of the cases of children, and only in about $\frac{1}{16}$th in the adult. Again, tubercles of the intestines were found in only $\frac{1}{11}$th of the children, while in the adult they were met with in every fourth case. On the contrary, tubercle of the bronchial glands is much more common in the child than in the adult, or in the ratio of 4 to 1. It will be seen also that tubercles of the brain and meninges are more frequent in the child than in the adult, nearly in the ratio of 3 to 1. Tubercles of the lungs, it is admitted, are more frequent in the adult than in the child. Indeed the lungs are so constantly the great primary seat of tubercles, that Louis, after examining upwards of 350 adults that had fallen from phthisis, affirms it to be a *law* to which there are few exceptions, " that in the adult tubercles are never found in other parts of the body without the lung be also similarly affected." In the child, however, the exceptions to this law, according to Lombard, amount to one-third of the whole number of cases. Having thus stated the general laws of tubercle, it now remains to point out particular instances of this disease in the different organs and tissues.

Tubercles of the *brain* are often met with in children, and especially in those of a strumous constitution, between the ages of 1 and 12 years; after which they are rarely met with till after 20. In the child, the tubercular masses are most common in the hemispheres of the brain, and occupy indifferently the cortical and medullary substance, sometimes invading both. The cerebellum is also not unfrequently the seat of tubercle in children.

In the adult, tubercles of the brain are much less common than in children, and the parts situated above the centrum ovale are their most frequent seat. After those, the cerebellum, the meso-cephalon, the medulla oblongata, the spinal cord, the crura cerebri and cerebelli, the thalami opticorum, the corpora striata, the pituitary gland, and the commissura of the thalami,—instancing an order of liability to tubercle, says Andral, which by no means corresponds with that of inflammation or of ramollissement.

The tubercles found in the substance of the brain are generally few in *number*. In many instances we find but one; in others, two; and in no instance are they numerous. In *form*, they are generally globular; but although globular, occasionally their surface is unequal. In *size*, they vary from a small shot to a pullet's egg, and they have been met with still larger; the whole extent of one hemisphere of the brain or of the cerebellum having been either converted into a tubercular mass, or obliterated by its pressure.

Tubercles of the brain are often encysted. Gendrin affirms they are always so, and Léveillé is of the same opinion: the cyst is sometimes thin and adheres externally to the brain, while sometimes its internal surface sends processes into the heart of the tubercle. In other cases the membrane is of a remarkable thickness, fibrous, and even cartilaginous. The portion of the brain which surrounds the tubercle is often perfectly healthy; at other times it is congested, and at others in an almost diffluent state.

It is generally supposed that tubercles are first deposited in the brain in a fluid state, and that the aqueous portions are afterwards absorbed. After an uncertain time they undergo the process of softening, and pus is found at their centres. In a more advanced stage, the greater portion of the tubercles having been converted into pus, they have been mistaken for abscesses.

The spinal *cord* is also occasionally the seat of tubercles. A very beautiful specimen of this disease, situated in the lumbar portion, is to be found in the museum of St. Thomas's Hospital.

Besides the substance of the brain and cord being the seat of tubercles, their membranes are liable to this affection. Andral gives a case in which the anterior fifth of the pia mater covering the right hemisphere was studded with a great number of tubercles. Gendrin also gives another in which a softened tubercle was found between the dura mater and the arachnoid; and similar instances have been seen of tubercle existing between the rachidian dura mater and arachnoid, and also external to the rachidian dura mater.

Of Tuberculoma of the Lungs, or Phthisis.

The deposition of tubercular matter in the *lungs* is termed *phthisis*. In the lungs the tubercular matter is secreted either as granules, or in larger masses, or it may be infiltrated into the substance of the lungs. We find it also in the grey semi-transparent state, converted into crude tubercle, and also transformed into pus. Each of these states may exist, *per se*, in the lung, but more commonly all these different states exist in the same lung and at the same time.

When death arises from the presence of the grey semi-transparent tubercle, the lung, on being torn, presents a granular surface, caused by the presence of myriads of miliary granulations, rather smaller but most resembling, except as to colour, the granules of boiled sago; while in other parts the tubercular matter is more fluid, less formed, and consequently infiltrated; and here and there may be met with granules undergoing the conversion into crude tubercle.

The patient more often falls in the second stage, or after the grey tubercular matter, or a considerable por-

tion of it, has been converted into crude tubercle. In this stage the granular form has disappeared, so that the lung, at its most diseased portion, appears infiltrated with crude tubercular matter. It is in this stage also that we sometimes find the tubercle deposited in large circumscribed round masses as big as a nut, a walnut, or an egg.

When the patient falls in the last stage, or after the tubercular matter has ripened, softened, and been converted into pus, we find, if the lung contains the large crude round tubercle, that this process has begun in the centre, and proceeds from that point to the circumference. But when the matter has been infiltrated, as it more commonly is, this softening appears to commence at some internal but undefined portion of the diseased part, which proceeds till at length an abscess forms, which, for the most part, ruptures into one or more bronchi, and the pus is now thrown up by coughing.

In whatever stage the patient may fall, the deposition of tubercular matter does not take place with equal frequency in all parts of the lungs, but is principally limited to the anterior and superior lobes, only rarely affecting the inferior or posterior lobes.

In general both the superior lobes are affected, since Louis, out of 100 cases, only met with five instances in which it was limited to the left lung, and only two in which it was limited to the right lung. Posthumous examination also seems to show that the tubercular matter is deposited in crops in the superior lobes, and generally in three crops; that at the root of the lung, and immediately under the clavicle, being riper and more advanced; that in the middle portion in the crude state; and that towards its summit in the grey or granular state; showing, if the tubercular matter follows a similar course in different parts of the lung, that it must have been deposited at different times. Louis found only two exceptions to the law of the greater tendency to ripen under the clavicle.

When the tubercular mass is completely softened and converted into pus, the abscess formed is termed by the old masters, vomica; and by Laënnec, "*caverne*." The dimensions of the vomica are very various, sometimes not so large as a pea, while others occupy nearly the whole lobe. There may be only one vomica, but more commonly there are two or more; and, when multiplex, they may be isolated, or else communicate by fistulous openings. Sometimes they are deeply seated in the centre of the greatest thickness of the lung, while in other instances they are so superficial that the only remaining wall is the pleura, and this occasionally ruptures, causing pneumo-thorax, followed by pleurisy. In most cases, however, the abscess ruptures into one or more bronchial tubes.

The interior of the vomica is occasionally uniform and circular, but more commonly it is irregular and broken, and coated by a thin muciform matter rarely susceptible of organization. Besides being irregular, the cavity of the vomica is often traversed by portions of condensed pulmonary tissue infiltrated with tubercular matter. In very rare instances, says Laënnec, I have found *blood-vessels* in these "*brides*," or columns, but more commonly, if not constantly, they are *obliterated*. Indeed, it appears to be a law to which there are few exceptions, that the deposition of tubercular matter is so effected as to turn aside the blood-vessels without the walls of the vomica, and, by pressure, to flatten and obliterate them. It is extremely rare, consequently, for a vessel to be met with either in the abscess or in the tubercular mass; so that, if the lung be injected, the colouring matter seldom reaches the cavity. M. Guillot, however, by a series of minute injections, dissections, and microscopic observations, has further investigated the condition of the immediate walls of the abscess, and asserts that although no large blood-vessel is to be found within a considerable distance of the vomica, yet, after a time, a series of most minute vessels hardly a millimetre in diameter creep over the interspace between the periphery of the tubercle and the pulmonary artery, and communicate either with the bronchial arteries, or with the arteries of the thoracic walls, by many of the adhesions or false membranes. The congeries of these vessels under the microscope present an appearance of velvet; and in this manner, says M. Guillot, the blood is once more brought in contact with the atmospheric air, and returned to the heart by the pulmonary and bronchial veins, and by the vena azygos. If this statement be confirmed, it results, that the greater the extent of tuberculoma of the lungs the greater is the capacity of the capillary vessels for arterial blood, and may account in some measure for the florid appearance so often met with in the phthisical patient.

On the contrary, the tubercular matter is generally deposited *around* and in the bronchial tubes, and by its pressure quickly obliterates them; so that we never find bronchial tubes passing through a cavity, but always find them, as it were, closely cut off at its walls. This obliteration may constantly be shown, as it is rare to find a cavity, however small, into which one or more of the bronchial tubes do not open.

The walls of the vomica are formed sometimes by healthy condensed pulmonary tissue; at others by pulmonary tissue infiltrated with tubercular matter in some or all of its different stages; and occasionally by pulmonary tissue in a state of inflammation, or, according to Louis, in one case in 18. The matter contained in the vomica is often a white or yellowish pus, intermixed with portions of broken-down tubercular matter; but, in general, it may be said to vary from a bloody sanies to a laudable pus.

The ancients thought that vomicæ were capable of healing, if not of cicatrizing, and Laënnec conceives that his researches have proved this to be the fact. The process nature adopts to attain this end he conceives to be as follows: instead of the muciform matters which usually line the vomicæ, a distinct membrane is formed and organized, and which, instead of secreting pus, secretes a serous fluid. This membrane gradually becomes cartilaginous, and forms a cyst lined with a mucous membrane. The cyst thus formed may either communicate with the bronchi, or it may be closed and filled with a cretaceous or other matter. The objection to phthisis being cured in this manner, is, that many pathologists with extensive opportunities have never seen such a cyst. Another mode in which the abscess is supposed to heal, is by granulations after the manner of ordinary abscesses, and that its site is marked by a linear cicatrix of condensed cellular tissue. It is certain that these cicatrices are often met with when the lung is otherwise healthy; and one or more bronchi may sometimes be found terminating in them as in a cul-de-sac; but that they denote the healing of a vomica and not the healing of an ordinary abscess, or a ruptured air-cell, is by no means established. The possibility of a tubercular abscess healing and cicatrizing may per-

haps be established; but it must be admitted to be a circumstance of most rare occurence, and a singular exception to the general law of phthisis, being almost invariably fatal.

In examining the bodies of those that have died of phthisis, we find the lungs are not the only organs that have suffered in the general destruction that disease has inflicted on the human frame; for we discover a vast extent of disease either directly or indirectly set up in other organs of the body. Louis has, with great labour, noted the different concomitant affections which he observed in 102 persons dead of phthisis; and though they differ in some of the numerical statements from what has been observed in this country, they are perhaps the nearest approximation to the truth we possess.

Out of 102 phthisical patients, Louis found—

The epiglottis ulcerated mostly posteriorly in	18
Larynx ulcerated	23
Trachea ulcerated mostly posteriorly.	31
Acute final pneumonia	$\frac{1}{10}$

The bronchi were widened, thickened, or reddened, or presented small ulcers very frequently when leading from excavations. Louis also conceives bronchitis to be always produced when pulmonary tubercles soften. Pleuritic affections were nearly as constant as the bronchial affection, and he finds an uniform proportion between these two affections and tubercular disease.

Complications affecting the Alimentary Canal.

Of 96 phthisical stomachs $\frac{1}{5}$th only were healthy.

They were softened, thinned, reddened, thickened, or contracted in $\frac{3}{4}$ths of the cases; ulcerated in 2 cases.

The duodenum was ulcerated in 3 cases; follicles enlarged in some instances.

In the small intestines the patches of aggregate glands were ulcerated in $\frac{4}{5}$ths; while the mucous membrane was sometimes reddened, and but rarely softened and thickened.

In the large intestines ulceration a little less frequent, but more extensive than in the small.

Softening of mucous membrane in $\frac{3}{4}$ths of the cases of large intestines.

The mesenteric glands tuberculous in $\frac{1}{4}$th, mostly toward the cœcum.

The peritoneum in 4 cases recently inflamed.

1 case semi-transparent miliary tubercles.

The peritoneum, the mesentery, and omentum were thickened and tuberculous, and the seat of effusion in $\frac{1}{4}$th of the cases.

Of the Accessary Organs.

The liver was fatty in $\frac{1}{3}$rd of the cases.

The heart was generally reduced in size.

Pia mater infiltrated with serum in $\frac{2}{3}$ths.

Brain universally or partially softened in $\frac{1}{10}$th.

Of the preceding complications Louis considers all tuberculous deposits, ulcerated air-tubes and bowels, and fatty liver as proper to phthisis.

Such are the principal lesions found in phthisis.

Besides tuberculoma occurring in the substance of the lungs, the *pleura pulmonalis* and *costalis* may also be the seat of tubercular deposit. In the museum of St. Thomas's Hospital is a specimen in which a considerable number of tubercles, about the size of a bean, are situated immediately under the *pleura pulmonalis*, and having scarcely any connexion with the lung. When deposited in the sub-costal pleural tissue in the form of tumors, they vary in size from a millet-seed to a large pea. When miliary, these tubercles are often exceedingly numerous, amounting to many hundreds, and are generally found in a crude state; but instances have been met with of both the other stages. In other instances the tubercular matter is infiltrated into the substance of the pleura, and sometimes exuded at its free surface.

Laënnec has only met with three or four instances of tubercles deposited in the walls of the *heart;* and Dr. Baillie mentions only three cases in which there were tumors of this kind, each about the size of a walnut. Tubercle in the walls of the left ventricle occurred some years ago in St. Thomas's Hospital, in a man whose heart was greatly enlarged; it was about the size of a large bean, and softened. Tubercle of the heart is unquestionably a rare form of this disease.

Of Tuberculoma of the Alimentary Canal and of its Auxiliary Viscera.

Tubercles have been met with in the tonsils; and Dr. Baillie states that he once met with a scrofulous swelling at the lower end of the *pharynx* and beginning of the œsophagus. It formed on that side of the pharynx which is next the larynx; and from this circumstance the patient had not only lost the power of swallowing, but was unable to speak except in the lowest whisper.

Tubercles are so rare in the stomach that Andral, notwithstanding his extensive pathological researches, only met with them twice or thrice. They are more common in the small intestines, especially towards its lower portion, and are again rare in the large intestines. They have three seats, or the sub-mucous cellular tissue, the interstices of the muscular fibres, and the sub-peritoneal tissue. In size they vary from a millet-seed to a pea, while, as to numbers, sometimes there is only one or two found throughout the whole intestine; but in other instances they are numerous. The mucous membrane around them may be healthy, simply injected, or ulcerated.

The *Spleen* is rarely seen affected with tubercles in the adult, and not commonly so in children. But in either case it is rare to meet with them in the spleen unless tubercles exist also at the same time in the lungs.

The *Liver* is more commonly the seat of tubercles than the spleen. They are sometimes extremely superficial, being seated immediately under the peritoneal covering, and in this case they are generally extremely numerous and small. In other instances they are deep-seated and large, varying from the size of a nut to an egg. There may be several, but their number is in general in the inverse ratio of their size, so that when large there is only one. They are commonly found in the crude state, and only rarely softened at their centre. Many pathologists have affirmed that they are never found in the grey semi-transparent or first stage in the liver, and the fact is certainly extremely doubtful; but in a case that died some years ago at St. Thomas's, a cyst was found containing a fluid which, from its grey gelatiniform character, appeared to be tubercular matter in its earliest state, and a similar instance or two may be found in other writers. The substance of the liver

around these tumors is often healthy. Tubercles have also occasionally been found in the walls of the gall-bladder, and M. Lugol once found one as large as a walnut in the cystic duct.

Tubercles have occasionally been found in the *pancreas*, and Lobstein speaks of having met with five instances of them in this viscus in children. But still they are rare, for Lugol never met with an instance, and few authors have made any mention of them as incident to this organ.

In the *Kidneys* tubercles are common, and they may invade either the cortical, medullary, or the tubular structure. There are seldom more than five or six, and these vary in size from a pea to a nut, but they have been seen as large as a walnut. They have hitherto been found only in the crude or else in the softened state : when softened they often cause large and destructive abscesses of the kidney, with great thickening and enlargement of the ureters. Tubercular matter has also been found between the coats of the ureter, or secreted at its surface.

The *peritoneum* is also frequently the seat of tubercular deposit, both in the child and in the adult, and is one of the *tabes mesenterica* of pathologists. Its seat is the sub-cellular tissue, not only of the portion covering the walls of the abdomen, but also of that covering the intestines. In size the tubercle is not bigger than a millet-seed, but they are numberless; in general some slight inflammation of the peritoneum, attended with effusion of serum, usually accompanies it. When the peritoneum likewise is the seat of adhesion, or is covered by a false membrane, tubercular matter is very constantly deposited in the connecting cellular tissue in the substance and at the surface of the false membrane.

Of Tuberculoma of the Glands.

In the *cervical* glands tubercles have long been designated by the name of Scrofula or *King's evil*. Indeed, the scrofula of the older pathologists for the most part was limited to tubercular affections of the glands. This disease may take place in infancy and in very early life, but it is much more common towards the end of the first or of the second septenary period, and indeed is met with at every period before 30. The tumors they form may exist on one or both sides of the neck; but, when double, they seldom attain the same excessive magnitude on both sides. Their volume is very various, sometimes hardly exceeding a plover's or a pullet's egg; but in other instances they acquire a size which may be termed monstrous, extending in bunches from the mastoid process to the middle of the lower jaw, to the clavicle, and even below it; and this formidable mass is sometimes increased by meeting with a continuous chain of enlarged axillary glands, and even with tubercles lodged in the mediastinum. When the disease is thus extensive the patient often dies from pressure on the larynx and trachea. On examining these vast tumors we generally find them to consist of a number of enlarged glands loaded with, or entirely converted into, tubercular matter, a few of them being softened in the centre. This mass of disease is usually surrounded by cellular tissue, more or less in a state of suppuration. The axillary glands are subject to a similar enlargement of firm tubercular deposits.

The *mesenteric glands* are often the seat of tubercles; and this is another of the forms of "tabes mesenterica." Many pathologists, however, and among them Lugol, consider the loose cellular tissue of the mesentery, and not the mesenteric glands, to be the seat of the tubercular deposit. Bœker has often injected, he says, the lymphatics with mercury in this disease, and has always found the injections pass freely through the glands; whence he concludes its seat to be the cellular tissue, and more especially that immediately surrounding the gland. It is probable, however, that both views are correct; and the latter accounts for the very considerable *embonpoint* which is sometimes seen in these cases. Still, in whatever tissue developed, the tubercular masses are often numerous and generally large, varying from a nut to an orange. Indeed, in no other region, says Lugol, do we find the masses of such a magnitude. These tubercles are often seen softened in the centre and very constantly contain calcareous matters, and are moreover often partially converted into bone. They seldom cause ulceration of any part of the intestine except the cœcum, with which, from its being bound down, they occasionally contract adhesion, and thus it becomes involved in the disease. In the great majority of these cases the body is singularly emaciated.

The *inguinal* glands are also in a few instances the seat of tubercles, and by their enlargement often make pressure on the nerves and blood-vessels about the abdominal ring, rendering this disease, generally void of pain in other parts, one of great suffering. The disease at length spreads to the deeper-seated glands, and the patient dies exhausted either by long-continued suppuration, or else from inflammation excited in the peritoneum.

The *bronchial* glands are perhaps in children as frequently the seat of tubercle as the cervical or the mesenteric. Those situated at the lower extremity of the trachea are most frequently affected, and sometimes they attain a large size and contract adhesion to the lungs. Under these circumstances they occasionally soften, suppurate, and ulcerate into the bronchi or pulmonary tissue, and the patient throws up pus as from a vomica or pulmonary abscess.

Tubercular tumors are also found in the *ovaries;* and Lugol mentions a case in which this took place in a young girl in whom these morbid productions likewise existed in the folds of the mesentery, in the cerebellum, and in the lungs. Tubercle has also been occasionally seen in the *uterus*, in the *testicles*, in the *vesiculæ seminales*, and in the *prostate*, and also in the coats of the *bladder*.

Of Tuberculoma of the subcutaneous Cellular Tissue.

M. Lugol has seen two cases of tuberculoma in the cellular tissue immediately exterior to the bone. In one a tuberculous tumor successively destroyed the zygomatic process, a portion of the sphenoid, and also of the petrous portion of the temporal bone, so that it lay in contact with the dura mater. In the other case, a subcutaneous tubercular tumor gradually perforated the sternum, and thus arrived at the anterior mediastinum. Tubercles are also formed in the subcutaneous tissues of the face, forming "*acné*." They also sometimes form underneath the skin of the arms or thighs, or in the posterior region of the neck. The most general instance, however, of subcutaneous tubercle is in *Elephantiasis*, when the face, arms, hands, legs, and indeed almost every part of the superficies of the body is the seat of an endless succession of tubercles, forming, ripening, suppurat-

ing, ulcerating, and healing; thus keeping up a ceaseless irritation, destroying the health of the patient, and producing a singular, thickened state of cutis and cellular tissue, the former becoming a dark brown *intermingled* with numberless white cicatrices.

Of Tuberculoma of the Bones, Muscles, and Blood-Vessels.

Tubercles are occasionally formed in the very centre of the long bones, as the tibia, humerus, or femur, and the tumor is frequently surrounded on every side with healthy osseous tissue. More commonly, however, the tubercular matter is infiltrated generally into the cancellous structure of the small bones, as into the tarsal and metatarsal bones, the carpal and metacarpal bones into the heads of the long bones, the petrous portion of the temporal bone, and into the cancellous structure of the vertebræ. In these cases the osseous substance becomes so softened, so entirely deprived of osseous matter, as to be readily cut with a knife; or else so broken down by the superincumbent weight of the body, that the limb becomes shortened, as in hip disease; or else the person becomes permanently deformed, as in the hunch-backed.

Tubercles may be generated in the muscular tissue, and Lugol has met with them embedded in the psoas muscles, and entirely isolated from every other structure.

Symptoms.—As a general principle it may be affirmed that tubercular matter, being first deposited in a soft if not fluid state, and by an action either entirely void of all inflammation, or else of an achromatous character, is unattended with pain, and therefore gives little note of its early existence, except by some slightly impaired function of the organ or part diseased. Again, when the tubercle undergoes its transformation into the hard yellow opaque substance or crude tubercle, this change is often so gradual that the parts accustomed to its presence may even now be only slighty irritated. It seems an established law, however, that when the tubercle is about to soften, that the constitution not only takes the alarm, but great local and general irritation is now set up, and the patient's life, if the part be vital, rapidly verges towards a close. As the course of the disease is extremely short in some cases and extremely long in others, it may be *acute* or *chronic*.

Symptoms of Tuberculoma of the Brain and Spinal Cord.—Dr. Hennis Green has given an analysis of the symptoms observed in 30 children that died in the hospitals of Paris of tuberculoma of the brain. Thus in four cases no cerebral symptoms existed; in two it was only marked by periodic headache; and in two by deafness and purulent discharge from the ears. In nine cases the symptoms were those of acute hydrocephalus,—as headache, vomiting, amaurosis and convulsions; a few with symptoms of softening; while the rest died of consumption and of small-pox. The duration of these symptoms was very various, or from one month to three years. Other observers have mentioned great fretfulness of temper, contraction of the limbs, with a frightful degree of emaciation.

In the adult the formation of tubercle of the brain is often equally latent. In other cases, however, intense and continued frontal headache, tearing from the patient the frightful hydrocephalic cry, vomiting, impaired intellect and impaired motion, with perhaps occasional attacks of epilepsy, are its effects. Still these symptoms only denote an injured state of the brain, without indicating the particular cause, the same symptoms accompanying many other tumors and diseases of this organ. It seems, however, to be a received opinion that tuberculoma of the brain is seldom or never met with after the age of 45. The duration of this affection is often long, but the acute symptoms rarely last more than a week to a fortnight.

Tubercles of the cerebellum are still more rare than of the brain, and Andral has deduced from 20 recorded cases the following as their symptoms,—headache in 17; continued fainting and vertigo in 1; the sight weakened or lost in 7; the intellect impaired in 5; convulsions in 7; palsy in 8; vomiting in 10, while the genital organs were only abnormally excited in one.

The following case, given by Bayle, of tubercle in the medulla oblongata, shows the latency of the disease as well as also the occasional symptoms to which it gives rise. A man, aged 24, had laboured for some time under the ordinary symptoms of phthisis. Three days, however, before his death, he was seized with incessant twitchings of the tendons of his right hand, while his urine and fæces were passed involuntarily. Twelve hours before his death his fingers were bent on the palm, the hand on the fore arm, and the fore arm on the upper arm, and this affection was more marked on the right than on the left side; his face was also convulsively twitched. A tubercle about the size of a nut was found a little above the corpora pyramidalia and olivaria.

The symptoms of formation of tubercle of the cord are equally uncertain. In some cases the patient suffers atrocious pains in the back, while in others little or no pain is felt, but all below is benumbed or palsied. The following sketch of this disease in a man aged 54, and given by Gendrin, is perhaps a fair generalization of the symptoms. The first symptom was numbness of the lower extremities, followed by a total loss of sensation, with twitchings of the limbs, but the patient was still able to walk with a stick. This power quickly ceased, and he was confined to his bed, and ultimately died from obstinate constipation, retention of urine, and gangrene of the back. In another case, in which an encysted tubercle was found softened at its centre between the fifth and seventh cervical vertebræ, the symptom was epilepsy.

Symptoms of Tuberculoma of the Lungs, or of Phthisis.—As a general law, it may be stated that the presence of tubercular matter in the substance of the lungs, whether in its semi-transparent, crude, or softened state, does not cause the slightest pain to the patient; and when pain does exist in the chest or between the shoulders, it proceeds entirely from the effects of violent coughing, or else from inflammation, of no very active character, of the pleura.

The greater number of cases of phthisis commence, then, with some slight cough, the sputa being hardly discoloured, or only slightly stained by a trace of pus or blood. The patient also is feeble, easily fatigued, has burning heat of the soles of the feet at night, and some perspiration in the morning; he is also irritable, his appetite capricious, and he is convinced of a sensible loss of flesh. At this period the sounds of the chest on percussion are healthy and perfectly sonorous under both clavicles, but the respiration is affected, being louder or more puerile in both lungs; or else it is feeble in one lung, and louder in the other, while the times of expiration are prolonged. These symptoms are accompanied by a

permanently accelerated pulse, from 80 to 90, while a more fatal sign is present, or that of the heart being heard beating all over the chest, showing that the lungs are condensed, and thus rendered a better conductor of sound. This stage or state of things may last a few weeks or a few months; and even the patient often revives, and seems to an unpractised eye, for a short time, to have recovered his good general health.

The disease, however, silently proceeds, and all the preceding symptoms are gradually but sensibly aggravated. The hectic becomes permanently established, and the sweat from the head and chest towards morning is often so profuse that the patient lies deluged, and is obliged to change his linen; the cough is more distressing, the sputa purulent, the hæmorrhage more constant, and the pulse more frequent, or from 90 to 110. He now often vomits after each meal, and the emaciation consequently is well marked and decided. On percussion, also, a dull sound is now returned from under the clavicles; on auscultation we hear bronchophony: the heart's action is still more palpable over the chest; the respiration is accompanied by some mucous râle; while the times of expiration are still further prolonged. The duration of this stage is very indefinite, or a few weeks to many months, and during its progress the disease occasionally intermits and becomes latent, so that there is for a time often a marked amendment, and the patient regains some strength.

The third and last stage of this eventful disorder is that in which the tubercle softens and an abscess forms. In this stage all the preceding symptoms attain their highest degree of intensity; the hectic is now often followed by a cold clammy sweat; the appetite is lost; a colliquative diarrhœa often supervenes; the sputa are often pure, as from an abscess, but at length become æruginous, or little more than a rusty sanguineous mucus; the pulse rapidly increases to 110 or 150; the emaciation is frightful; and nothing, indeed, appears to survive this general wreck but the mind, which is often firm, collected, and even hopeful to the last. In this stage the phenomenon on percussion has undergone another alteration; the dull sound returned in the second stage now giving place to an unnaturally clear sound, in consequence of the introduction of air into the cavity of the lung; and, according to the condition of the abscess, we have now the râle amphorique, or the tintement metallique; while the mucous râle is for the most part tracheal. It is remarkable, however, that as soon as the abscess bursts the cough is often greatly relieved. The duration of this stage is generally shorter than the former, but still, notwithstanding the existence of one or more abscesses, it often lasts many months. Such is a short outline of the course and phenomena of this destructive disease, which sometimes terminates life within a month, a few weeks, often in a few months, while it occasionally lasts many years. The following is a short analysis of the principal, local, constitutional, and stethescopic symptoms of this remarkable affection.

Affection of the *Bronchial Membrane* is certainly the most frequent concomitant symptom of phthisis, but the part of the bronchial membrane affected is not always the same; most commonly the mucous membrane of the smaller bronchial tubes is first affected; then that of the larger ones, the disease gradually ascending till it often ends in a chronic laryngitis, with a partial or total loss of voice. In a few cases, however, this order is inverted, and almost the first symptom is a laryngitis, with hoarseness and constriction of the throat; after which the disease descends to the larger and then to the smaller bronchi, when the patient begins to expectorate; his pulse becomes hurried; he loses flesh; and all the unerring symptoms of phthisis are established.

The *expectoration* which takes place in phthisis from the bronchial membrane is usually purulent, the pus thrown up in the early stages being for the most part of good quality, and formed into "sputa," sometimes sinking and sometimes swimming in water; and may be either of a sweet, insipid, or saltish taste. As the disease advances, it is often thrown up pure, as from an abscess, and without any separation into sputa, and is sometimes mixed with particles of a curdy substance.

In the last stages it is often of an æruginous green, a dirty sanies, or a rusty muciform serosity. The quantity expectorated varies greatly; sometimes only a few sputa, or not more than half an ounce in the 24 hours, and then perhaps more than a pint in the same period, so that in a few weeks the patient has often expectorated more than his own weight of pus. If a small abscess has burst into the bronchi, the sputa, though something increased in quantity, are hardly changed in character; but if the abscess be large, the quantity thrown up is proportionally great, and *en masse*.

In a very few instances the commencement of phthisis is marked by the expectoration of a cretaceous matter, or of small calculi, or of small portions of ossified cellular tissue. In some rare instances, also, the patient dies of *Phthisis sicca*, and without suffering from any expectoration whatever. If the bronchial membrane be examined after death it rarely presents any definite trace of inflammation; and Louis considers it to be in general healthy, except in those tubes which lead to the vomica or abscess. It appears, therefore, to be a strictly achromatous inflammation

Hæmorrhage may precede, or be contemporaneous with, or succeed to, the bronchial affection. If it precedes, the patient being, as he imagines, in excellent health, is suddenly seized with hæmoptysis, followed perhaps by cough. This attack subsides, but a second and a third follow, till phthisis is established. Hæmoptysis more commonly, however, occurs later in the disease, increasing the debility, aggravating the symptoms, and hastening the fatal catastrophe. The quantity of blood lost is very various; sometimes only enough to streak the sputa, at others a few tea-spoonfuls, but in some instances is so profuse as to amount to one, two, or more pints. In the still more advanced stages, though cases occur in which the quantity of blood thrown up is very great, yet more usually it is trifling, and more resembles a bloody sanies than pure blood; indeed, from the generally small quantities of blood thrown up in phthisis, it is almost an axiom in medicine that trifling hæmorrhages are more dangerous than large ones. The blood thrown up may be florid or dark coloured; in either case it probably escapes from the same vessels, the colour varying according to laws not yet determined.

The *cough* is as variable as the other symptoms. In some few cases the patient dies from tubercles in the lungs, and yet no cough is present. More commonly, however, the cough is troublesome, and often intense, so that every change of position, even turning in bed, the act of speaking, of eating, or of drinking, gives rise to it. Often it returns in fits or paroxysms, occurring at

uncertain periods. It is singular that, as the disease advances and large abscesses open, that the cough, which was at first frequent and troublesome, often becomes comparatively tranquil, or is only excited to expel the purulent matter collected in the bronchi. A tickling cough usually denotes some affection of the glottis and larynx, parts which are more irritable and more abundantly supplied with nerves than the trachea or bronchi.

The *dyspnœa* is generally great in phthisis, the patient being unable to make any active exertion, or even to read a few lines without pausing. The dyspnœa, however, is not always proportioned to the amount of mischief; for there are instances in which the respiration has been performed with facility, even when two-thirds of the lungs have been in a state of tuberculoma. It is doubtful whether adhesions, unless very extensive, greatly affect the respiration. Should effusion of serum, however, or of pus from the bursting of an abscess, have taken place into the cavity of the chest, then the respiration is greatly impaired. The most common situation of the fistulous opening, caused by the bursting of an abscess into the chest, is the summit of the lung, or a little below the clavicle. It is usually very small, hidden by the lung, or so surrounded by adhesions that it is difficult to discover it. Again, when the abscess bursts not only into the chest but also into the bronchi, a "*triple opening*" is said to be established,and the disease is termed *pneumo-thorax*. When this latter event occurs, the life of the patient might be supposed to rapidly terminate, either by pleurisy or an entire exhaustion; but it is singular the patient often survives this state many days, sometimes a few weeks, and Louis has given instances in which two or three months elapsed before the death of the patient.

The Stomach is supposed to be more or less diseased in three-fifths of the cases of phthisis; yet it so seldom gives rise to any well-marked symptom that for the most part the affection may be said to be latent. In the worst cases the symptoms are only a capricious appetite, indigestion, some pain in the epigastrium, and vomiting after coughing.

The intestinal canal is at least as frequently affected as the stomach in phthisis; but in general the abdomen is without pain, and, in the early stages of the disease, supple. The only marked circumstance connected with this viscus in this stage is, that the stools are more copious than in health, the body being unable to appropriate the accustomed quantity of nutriment prepared by the stomach. As the disease advances the patient often suffers from irritable bowels, or from diarrhœa alternating with constipation; while, towards the close of the disease, the diarrhœa often becomes colliquative, hastening the fatal result. In some very few instances the peritoneum ruptures, and the patient dies of *peritonitis*, while in a somewhat larger number *Dropsy* takes place—Louis says in one case in four.

The Liver undergoes a fatty degeneration in about one-third of the cases, and so remarkable a lesion might be expected to give rise to some particular symptoms; but this is not the case; it may occasionally be felt somewhat enlarged, but neither pain, nor altered state of the secretions, or other circumstance, denote its diseased condition.

Of Hectic.—In some very few cases the patient passes through this disease without any attack of fever; but in the large majority of persons no sooner is the "crude tubercle" established than the constitution suffers, and hectic of a marked character appears. The simplest form of this fever is a periodical return of a burning heat in the palms of the hands and soles of the feet. More commonly, however, the hectic fever is more complex, and the patient is seized with quotidian paroxysms of intermitting fever, so that many patients consider themselves to be labouring under that disease, the paroxysm consisting of shivering, fever, and profuse sweats. The time of the recurrence of the paroxysm varies, for it may come on in the morning or in the middle of the day, but is most common perhaps in the evening.

In many instances one or more of the stages of the paroxysm is wanting. Thus many patients suffer once in the twenty-four hours from coldness and shivering, without these being followed either by fever or sweating, and in like manner the paroxysm may consist solely of the hot or of the sweating stage. More commonly, perhaps, the paroxysm consists of two stages, as the cold stage and the sweating stage, or of the hot stage and of the sweating stage. The cold clammy perspirations which mark the former are the horror of every person labouring under this complaint. In the latter the attack generally takes place about five o'clock in the morning, when the patient awakes drenched in a perspiration so profuse that his body and bed-linen may be wrung. His head and chest are the parts from which it principally flows, and as the paroxysm subsides the urine often deposits a pink sediment. Louis found that in about one-fifth of his cases the attack of hectic was established before any abscess or cavity was formed in the lung, while in three-fifths it was deferred till after a cavity or vomica had formed, whence he concludes that the constitutional affection is not the result of the formation of pus, but is a law incident to tuberculoma generally.

The pulse is, in a very few instances, of its normal frequency throughout, or nearly so, the whole of the disease, but in 99 cases out of 100 it is small and accelerated in every stage; or, while the disease is yet incipient, it ranges from 84 to 96; in a more advanced stage it varies from 110 to 120, and towards the close of the case it often exceeds 130, 140, or 150, so as hardly to be counted. In many instances the pulse continues stationary at about 96, till the hectic comes on, when it becomes rapid, but as the fever subsides it again returns to its usual beat.

The emaciation so remarkable in this disease is common to nearly all the tissues of the body, as the adipose tissue, the muscles, the bones, and even the intestines and skin are thinned. This emaciation often commences even before the disease can be said to be well established, so that the patient has often lost one or two stone before he applies for medical advice. In the more advanced stages the rate of emaciation is singular, the party losing perhaps three pounds in one week, and gaining two pounds and a half in the next, and this alternation of gain and loss goes on for many weeks, or months, always leaving a balance against the patient. Towards the close of life the loss greatly surpasses the gain, and occasionally amounts to four, five, six, and seven pounds in a week. The total loss the patient sustains is perhaps from one-third to half his whole weight.

The *mind*, though not capable of exertion, is perfect throughout the disease, or only wanders during the few

last days of existence. It is seldom the patient dreads the future or despairs of the present, for nature, however threatening his symptoms, has imparted a singular buoyancy to his hopes, and he is always better; would be quite well but for his cough; feels able to take a long walk, and enjoys in expectation his meals; yet, with all this, he faints if he attempts to cross the room, and nauseates his food when brought to him.

Such are the general and local symptoms of phthisis, and which are sufficient indications that the lungs are diseased. The stethescope, however, adds many interesting additions, and enables us to determine not only that the lung is diseased, but the particular part of the lung which is diseased, and likewise the present state of the diseased part; and thus the discoveries of Laënnec and of Avenbrugger have rendered the diagnosis of Tuberculoma of these organs almost as perfect as though the disease was exposed to sight.

Physical Symptoms.—If we uncover the chest of a patient labouring under cough and other symptoms of incipient phthisis, we observe nothing remarkable, except as a general rule that its transverse diameters are small. If the disease be further advanced, we find the patient emaciated, together with a singular immobility or incapacity of dilatation of the portion of the chest immediately below the clavicle, so that he breathes chiefly by his shoulders and diaphragm, and is unable to "fill his chest." In the latter stages of the disease, the whole of the affected side of the chest, viewed anteriorly, is perfectly motionless; at a still more advanced stage, if an abscess has burst into the cavity of the pleura, and caused *pneumo-thorax*, the affected side is not only motionless but distended, and as it were bulging out. The examination of the bared chest, therefore, often affords valuable data for forming a diagnosis in phthisis.

If we apply the stethescope to the chest in incipient phthisis, the action of the lungs is perhaps little impaired, but we hear the heart beating all over the chest, and at a rate which varies in different subjects from 90 to 100. This symptom, if heard repeatedly, is always of anxious portent, for it denotes the density of the lungs to be increased, and thus rendered a better conductor of sound, and no cause is so constant of this change of density as tubercular infiltration. At this period air permeates the pulmonary tissue generally, so that percussion is still followed by a clear sound.

In the second stage, or that of crude tubercle, the density of the lung is still further increased, and the heart is consequently heard still more distinctly beating all over the chest. We have also the phenomenon of bronchophony. We hear the louder pulmonary *bruit* in the healthier lung, and a more feeble one in the most diseased lung, accompanied for the most part with bronchial or tracheal mucous rhoncus. On percussion, also, under the clavicles, the sound now returned is dull.

When the tubercular matter is softened and forms an abscess or vomica, we have, when the conditions are favourable, pectoriloquy, but much more commonly only bronchophony. If the conditions also be favourable, we can determine by the absence or presence of the *souffle voilé* whether the abscess be superficial or deep seated; also whether it be large, for in this case we have the *râle amphorique;* or on the patient coughing, a gurgling or splashing sound, or else the *tintement metallique.* We can determine also whether it has burst into the cavity of the chest, causing pneumo-thorax; by the affected side of the chest becoming enlarged and motionless; and by the remarkable circumstance of the "*tintement metallique.*" On percussion, also, under the clavicle, every part of the chest, even that which so lately returned a dull sound, now returns an unnaturally clear sound.

In the first stage of phthisis, says Andral, the blood offers no peculiarity, except that the clot is generally small and dense, containing a smaller proportion of red globules than usual, while the quantity of fibrine is normal.

In proportion, however, as the disease advances, and that the tubercles soften and caverns form, the clot still further diminishes, but is covered with a buff, which is thicker and firmer in proportion as the disease is more advanced. Two circumstances contribute to the production of the buff, or the increase of fibrine, so common in the last stages of phthisis, and again the continued diminution of the red globules. The buff in the last stages of phthisis is as common as in pneumonia, or in acute rheumatism.

These are the general local and physical symptoms of phthisis, a disease which can only be confounded with chronic bronchitis. The diagnosis, however, between the two diseases, is often extremely difficult, sometimes impossible, the patients equally labouring under cough, expectoration, emaciation, and hectic fever. The absence, however, of the dull sound on percussion, as well as of pectoriloquy, give a reasonable ground for believing that the disease may still be classed as bronchitis, and that the patient is not labouring under phthisis.

The *Prognosis* is universally fatal.

Of the Symptoms of Tuberculoma of the Alimentary Canal, and its accessory Organs.

No symptom is yet known by which tuberculoma of any portion of the alimentary canal can be determined during life; for the symptoms common to this disorder are common to many other alterations of structure, and even of function of these parts, and the only ground for inferring its existence is the fact of the patient labouring under phthisis. The leading symptoms are diarrhœa, and perhaps some slight peritoneal pain or irritation.

When tubercles form in the liver or spleen, those viscera are commonly greatly enlarged, but not the seat of pain or of much local inconvenience; the constitution, however, is at length affected, the peritoneum sympathizes, and dropsy follows. In the liver, when the tubercle is superficial and large, it may sometimes be felt through the abdominal walls during life. But the spleen being deeply seated, and the tubercle generally small, it may perhaps be inferred, but can seldom be discovered by the touch.

In the kidney, tubercles form in the same latent manner, and without pain. They also lead to dropsy; still the dropsy has no particular feature, so that until the kidney be examined after death, the real cause is seldom either inferred or discovered. In the event, however, of their determining an abscess of the kidney, the presence of pus in the urine, the lumbar pains, and the infrequency of abscess of that organ from any other cause, may lead us to infer the presence of a tubercle of the kidney.

The formation of tubercles of the peritoneum is perhaps equally latent, but from the irritable character of this tissue they shortly give rise both to local and constitutional symptoms. In general chronic peritonitis is set up, accompanied with much pain, increased on pres-

sure, and by a small and extremely rapid pulse, and this is shortly followed by effusion into the cavity of the abdomen. Tuberculated peritoneum may be distinguished, however, from chronic peritonitis by the previous hectic state of the patient and his great emaciation, and by the existence generally of tubercles in some other organ or tissue of the body.

Tubercles of the *cervical glands* often acquire a great size without giving pain. At length, however, they become inconvenient from their great enlargement, so that sometimes the respiration is greatly impaired by their pressure on the trachea, and death has ensued, notwithstanding tracheotomy has been performed,—a result which, as the patient breathes freely, seems to demonstrate that the disease is not only local but constitutional. When the tubercular deposit is small, the glands and surrounding cellular tissue often suppurate, and a troublesome discharge ensues, but ultimately the patient recovers with his neck scarred. This is one of the few instances in which the patient survives this formidable disease.

When tubercules form in the *inguinal glands*, the disease is perhaps at first latent; but no sooner does it become active, and suppuration takes place, than the disease spreads inwards, the peritoneum becomes affected, and the patient, for the most part, ultimately falls from this formidable complaint.

The deposition of tubercular matter in the *mesenteric glands* is similarly latent; for whether the disease be acute or chronic, the patient suffers no pain. The chronic form is the most usual, and the early symptoms are—an inordinate appetite, with loss of flesh, while the stools are much more copious than in health. As the disease advances the pulse becomes rapid, the emaciation extreme, the appetite capricious, or altogether lost, and at last a colliquative diarrhœa closes the scene. In a few cases this form of tabes mesenterica is acute, and its course so rapid that the patient falls before emaciation can take place. A woman about thirty-five was admitted into St. Thomas's Hospital with diarrhœa, sickness, and a rapid pulse, but no pain was caused by pressure over the abdomen. She died within a week, when, on examining her, the mesentery was found to be the seat of many tubercles, as large as small walnuts, of which many were softened and purulent at their centres. She was a corpulent person, and had at least two inches of fat on the ribs. Lugol has seen many similar instances of embonpoint, and considers that the glandular structure is consequently not the seat of this affection.

When tubercle is deposited in the *bones* of the extremities the disease is at first equally latent, but as it advances the sufferings of the patient are great, the cartilages become affected, suppuration takes place, fistulous openings are formed, while from the softened state of the diseased bones the superincumbent weight of the body crushes them, and the limb is shortened. If the disease be situated in the vertebræ these bones are equally broken down, so that pressure is made on the spinal cord; the patient now suffers great pain down the back, and the power of locomotion is often greatly impaired. The displaced parts, however, at length become accustomed to their new condition, and the disease often terminates by anchylosis; and this having taken place, the patient, though deformed, recovers, and perhaps ultimately enjoys a considerable share of health. If the disease should take place in the long bones, as the head of the femur or its condyles, there is the same latency, followed by great suffering, which often destroys the patient before the disease has run its course and the tendency to health restored.

The many tubercular affections to which the cutaneous tissue is subject, cause but little constitutional affection, neither is the local inconvenience great; the patient, indeed, is annoyed by the unsightliness they occasion, but even in elephantiasis he often survives many years.

Treatment.—It appears, from the preceding statement, that tubercle has a natural tendency in some tissues, as the bones, the cervical glands, and the cutis, after destroying or impairing the part, to terminate in the patient's recovery. When, however, the tubercular deposit takes place in the brain, the lungs, the liver, the spleen, or other important organ, the patient is uniformly destroyed. The treatment, then, of tuberculoma resolves itself into what can be done in those cases in which there is a natural tendency to a return to health; and, on the contrary, in those cases in which the termination is inevitable death.

When the tubercle, then, is deposited in the bones, in the cervical glands, or other parts in which there is a natural tendency in the disease to subside, it is important, whether suppuration has or has not taken place, to support the strength of the patient by quina, sarsaparilla, the iodide of potassium, or other tonic, as also by wine and a generous diet, and the disease thus treated sometimes subsides before the patient's health becomes irretrievably lost. It is remarkable that all local treatment in these cases, as by poultices, ointments, or washes, is in general injurious. In the event, however, of this treatment failing, it may be a question, supposing a joint to be affected, whether the patient should not be advised to submit to the amputation of the limb.

In the treatment of the far larger class of tuberculoma of those organs in which the natural and inevitable tendency is towards death, it is to be regretted that its fatal course is little if in any degree retarded by medicine. We possess no cure at present for tubercle of the brain; and it is admitted, with hardly an exception, by the whole medical profession, that we possess no remedy for phthisis; and the same admission must be made as to the impossibility of our at present curing or even influencing the course of tubercle of the liver, spleen, or kidney, or of the mesenteric or cervical glands, or of tubercle infesting serous or mucous tissues. The cure of all these forms of tuberculoma will probably ultimately be found to yield to some specific medicine hereafter to be discovered; but till that happy event shall take place, the resources of art are limited entirely to palliatives; we shall limit the few remarks we have yet to make on this distressing subject to the treatment in phthisis.

Phthisis has been often treated on every general principle that could affect the part through the medium of the constitution: thus the patient has been bled, both generally and locally, and the blood drawn has been in every quantity; but as a general rule it may be affirmed, that in proportion to the quantity of blood taken, so has been the rapidity and the fatality of the disease: counter irritations, also, of every kind have been employed; and yet, as far as we can judge, without any favourable results. The patient has likewise been treated with every known purgative, either to regulate the bowels, or else with a view to a more active operation, and also with every known emetic, either with the intention of easing the cough, or else of producing vomiting, and

yet the party has in no instance been ultimately benefited. In like manner, every tonic remedy has been tried; but the constitution has in no instance been so influenced as to lead us to imagine that the disease has been cured. The failure of every mode of *general treatment*, therefore, necessarily shows that the remedy, when discovered, must be of a specific character.

The number of substances which have been exhibited in the hope of finding this specific is quite remarkable; yet none of them has in any sensible degree affected either the symptoms, or the course of the disease, or visibly accelerated or retarded its so constantly fatal termination. Every metal of which half an ounce could be procured has been tried in some form or other, even to osmium, so difficult to procure, on account of its volatility, and yet without any sensibly good effect. One of the most remarkable results of these various trials is, that it has been found that minute doses of arsenic, exhibited for a few days, have improved the sputa, and appeared to benefit the patient, but if continued longer, the effect has been injurious; mercury is in every case injurious, and its use even predisposes to the disease. Every mineral acid has been tried, even to the fluoric, so seldom obtained without impurity, but with the same negative result. Each known vegetable acid has been put in requisition—as the tartaric, citric, gallic, benzoic, oxalic, and hydrocyanic, &c., but without benefit. Neither have the many alkalies now discovered, whether exhibited simply or in combination, been productive of any more satisfactory result. Almost every wood, and also the bark of almost every wood, has been alike tried for this great end, as also a numberless amount of seeds, as well as almost every bulbous root. The only substance, however, out of these extensive classes of possible remedies that has produced any very sensible result, was the cevadillo, which is supposed to contain veratrine; and in the small number of cases in which this was tried it appeared rapidly to enfeeble the powers of the patient, and to hasten his death.

In conclusion, every oil, whether fixed or volatile—every opiate, and every æther has been given—every gas, also, that the ingenuity of modern chemistry has discovered, has been inhaled without producing any sensible benefit. The extent to which these attempts to cure phthisis has been carried, has shown how very few of the substances with which nature has surrounded us are actually injurious, and is consequently a strong argument for pursuing this interesting path of inquiry; for the powerful remedies we possess in controlling and curing many other diseases is a most convincing reason that an antidote or specific remedy for phthisis will ultimately be discovered.

As the cure of phthisis is still a problem, the only hope of a family predisposed to this disease escaping is by prevention. But as the remote cause is so obscure, so the avoidance of it is a matter of vast doubt and difficulty. Still, it being well known that the artificial habits of domestic town life are more favourable to its production than those of a country life, it may be determined as a general rule, that a predisposed person should, if possible, reside in the country, accustom himself to exercise, and expose himself, when properly clothed, to the weather. It may be questionable, also, whether the habits of drinking everything hot, and everything impregnated with some foreign substance, as tea, coffee, chocolate, or beer, does not impair the digestive organs, debilitate the system, and facilitate the production of this disease. The stalled ox, artificially fed on boiled food and hot mashes, falls an easy and ready victim to this disease; and horses, it is well known, that drink foul and dirty water, although they become so fond of it as to drink none other, usually become broken-winded, or otherwise affected in the lungs.

After phthisis has formed, no question is more distressing to answer, when it is evident all our remedies are failing, than "What is next to be done?" Should the patient try change of air? Change of place, however, appears to suggest itself in all countries, but perhaps rather as a relief to the physician, than as an efficient resource for the patient. If the disease, then, break out in the Mediterranean, it is the practice to send the patient to this country to prolong his existence. Again, if it break out on the continent of America, the patient is sent to the West India Islands; and if in the West India Islands, he is sent to the continent of America. In like manner, it is the practice in this country to send the patient to the south of France, to Madeira, to Malta, or to Naples; but alas! how few return to boast of the benefits they have received.

It may be stated that diet has little influence over the disease, when once formed; and it is of little moment as to the ultimate result, whether the food of the patient be strictly animal, strictly vegetable, or whether it be mixed. It is perhaps also of little moment what sort of wine the patient drinks, and some have even drank pure æther, without sensible injury; even a strictly water diet would perhaps be little serviceable in the cure of the disease. The only useful directions, therefore, that can be given for avoiding this disease, is to live as much as possible in the open air, to change place as often as the convenience of the party permits, and perhaps in most instances to seek a more southern climate, when this point can be easily attained. The party ought also to wear flannel.

The disease being once established, we have only palliatives to assuage in some degree the symptoms. Mild opiates, as the syrup of poppies, afford great relief to the cough, and are remedies for which the patient expresses himself most grateful; the heavier opiates, however, are in general less beneficial, and often produce headache. Against the night sweats the infus. rosæ c. sp. ætheris nitrici ʒ j. 6tis horis is our best palliative. When hæmorrhage comes on, it is best met by the bitartrate of potash; but as we are combating a symptom, rather than an original disease, this potent medicine is often inefficacious; and where diarrhœa threatens to accelerate the fatal catastrophe, a few doses of the mist. cretæ comp. c. opio, or else a drachm of syrup of poppies after each stool, often give a salutary check to this rapidly debilitating state. The frequency of the pulse is seldom controlled by digitalis; and even when most successful, the patient is more distressed by the medicine than benefited by the result. Whatever other symptoms may arise should be treated in the mildest manner, and with our simplest remedies, for even removing the accident, however distressing, is always followed by a declension of power, which is rarely recovered from.

Phthisis is in many parts of the continent supposed to be contagious, and the clothes and bedding of the deceased patient are immediately burnt. There is no sufficient reason, however, from any evidence afforded by the disease in this country, to suppose this disease

can be communicated from one person to another. In some few instances a wife has appeared to have contracted it from her husband, or the husband from his wife; but in a disease of such common occurrence, such events must occasionally follow oue another, and can hardly be considered as remarkable or as necessarily connected; and, taking them altogether, they are too few to warrant the adoption of the doctrine of phthisis being a contagious disorder.

Order IV.—Of Carcinoma.—Cancer—a Crab.

Carcinoma is a peculiar morbid growth or substance, formed principally in the cellular tissue, but likewise in every other tissue and organ of the body. It was a disease well known to the ancients, and derives its name from the appearances it gives rise to in the female breast,—the superficial veins of that part, when affected with cancer, becoming enlarged, radiating, and having thus some resemblance to the claws of a crab. In modern times the development of its laws has employed the pens of Hey, Lobstein, Recamier, Andral, Carswell, Kiernan, and of many others. This formidable disease, according to the returns of the registrar-general, destroyed 2488 persons in England and Wales in 1839.

Carcinoma may be divided into carcinoma durum and into carcinoma molle, or into hard cancer and into soft cancer. This division is established on differences observed in their course, and in their phenomena, especially those of the second stage; also from their affecting, for the most part, different organs and tissues, as well as persons at opposite periods of life. It is probable, however, that in some instances, as in cancer of the breast, the two forms may co-exist. The cases of soft cancer are far more numerous than those of hard cancer, but the ratio is not determined.

Of Carcinoma Durum.

Remote Causes.—The remote causes of Carcinoma Durum are extremely obscure. For it appears to be connected with a particular idiosyncrasy or constitution; but how that idiosyncrasy is formed has not as yet received any elucidation. There seems little doubt, however, of its being constitutional; for if the disease occurs in a part capable of being amputated, and it be amputated, nevertheless the disease returns for the most part either in that or in some other part of the body. The disposition once formed, all that depresses the vital powers appears to be productive of this disease: thus great mental depression appears to have been an exciting cause in Bonaparte, who, after his endless series of disasters, ultimately died from cancer of the stomach. In other cases it appears to be caused by mechanical injuries, and from accidental exposure to the weather.

Predisposing Causes.—Hard cancer seldom occurs till after 40, and from that period the liability increases with age. Its connexion with age may be best exemplified by stating, that its more usual seat are those organs whose vitality or functions are considerably impaired by time. Thus it seldom occurs in the mammæ, uterus, or in the ovaries till after the cessation of menstruation—nor in the organs of generation of the male till towards old age, nor in the different portions of the alimentary canal till after 40. Cancer is supposed likewise to be in many instances hereditary, and to run in families. It also very constantly occurs in persons of considerable physical power, and remarkable for their patient suffering, as well as for intellectual superiority.

Pathology.—Carcinoma durum has two stages,—or a hard or schirrous stage, and a stage of softening.

In carcinoma durum the cancerous matter is always deposited in a hard or schirrous state, and the duration of this state constitutes the first stage. It may be deposited in *masses*, or else be *infiltrated* into the cellular tissue of the organ or tissue affected; and the latter is by far the most common form. When formed into masses they are generally lobulated, dense, and often contained in a cyst; again, when these masses are cut into, we find them to consist of two substances,—the one is the cancerous deposit or growth, and the other is cellular tissue; so that the appearance of the divided surface in general is that of a hard, white, semi-cartilaginous substance, streaked by fibres radiating from the centre to the circumference. They are of considerable density and firmness, and in hardness of texture vary from hard boiled white of egg to cartilage—the knife crying as it cuts through them.

The cancerous deposit, however, is much more frequently infiltrated into the cellular tissue of the different organs or tissues it affects. In this case the affected tissue becomes gradually increased iu thickness and in density by a slow deposition, or else growth of this matter, so that the part, if now divided, presents the same hard semi-transparent character as in the masses, but more interspersed with cellular tissue, the diseased portion being gradually shaded off into the healthy membrane or tissue. In the mucous tissues, as those of the stomach or uterus, the infiltrated matter has often a considerable thickness, measuring from a quarter of an inch to an inch, or perhaps even more. On the contrary, when infiltrated into the cutaneous tissue, the layer is often so attenuated as to be scarcely sensible, and the disease commences with little other appearance than a small hard pimple, or a small erysipelatous tumor, or even by a slight fissure or crack in the skin.

After a certain but indefinite period, which varies from a few months to a few years, the schirrous stage terminates, and the second stage, or that of *softening*, begins. In mucous membranes this softening usually takes place at their *surface*, or superficially,—as at the mucous surface of the neck of the uterus, or at the mucous surface of the stomach. An ulcer is the consequence of this softened state. and is at first superficial, and presents many remarkable varieties, as an inverted or everted edge—an irregular form. while its base may be granulating at one part and sloughing at another. Its course is burrowing, often penetrating between the cancerous lobules and perforating the peritoneum. The pus secreted by this sore is fœtid; often a mere ichor, or else pus mixed with blood, and so acrid as to inflame the parts over which it flows. In a few instances the large vessels participating in the disease ulcerate, aud the patient dies of hæmorrhage.

The duration of the schirrous stage of a cancerous tumor, it has been stated, is very uncertain, and may terminate in a few months, or may last several years. A cancerous mammary gland, for instance, has been known to remain indolent for 14 years, and has at the end of that time been removed by an operation. This indoleut character of carcinoma is limited, however, to the schirrous stage; for after it has softened, or its second stage commenced, its course is rapid, and a few weeks or a few months now generally terminate the patient's life,

Elementary Principles of Medicine.

the part affected in no instance cicatrizing, or being again restored to a healthy condition.

Mr. Hecht, jun., has examined the chemical properties of a large schirrous mammary gland, and also of a schirrous uterus, and his analysis is as follows:—

Schirrous mammary gland.

	Grains.
Albumen	2
Gelatine	20
Fibrine	20
Fluid fatty matter	10
Water and loss	20
	72

Schirrous uterus.

	Grains.
Fatty matter	10
Fibrine	10
Gelatine	15
Water	35
	70

It is remarkable that neither of these analyses show the existence of any of the usual salts of the blood, while calcination gave for a residue only five grains of carbon. The truth of these analyses, however, is questioned by Müller; for he says he has boiled these tumors from 18 to 24 hours, and only obtained a very small quantity of gelatine; he considers them to be for the most part albuminous, and to contain some caseine and salivary matter.

Many different opinions have been entertained of the origin and intimate structure of cancer, and also of its essential character. Adams considers it to be caused by an animal of the hydatid species, which he calls hydatis carcinomatosa. While Broussais considers it to be a product of inflammation, although there is hardly a trace of a blood-vessel to be seen either in the tumor itself or in the surrounding parts. As to its peculiar nature, as developed by the microscope, Müller considers it to be characterized by a number of spindle-shaped or caudate bodies; while Mr. Kiernan considers it to be composed of enlarged and varicose capillaries. With respect to its more essential character, some consider it to be a heterologue deposit, and devoid of organic life; while others view it as a substance or growth, enjoying an independent life, and attacking every organ or tissue that has a feeble vitality.

A more important question is, whether the secretions from a cancerous ulcer are contagious; and there is every reason to believe that this loathsome disease cannot be communicated. Alibert has made dogs swallow the ichorous serosity collected from a cancerous ulcer, but the health of those animals was not impaired. Dupuytren has likewise introduced portions of cancerous parts into the stomachs of many animals—has injected the pus into their veins, and into their different serous cavities, but without producing any other result than any other irritating matter would have caused. Women also having the neck of the uterus destroyed by carcinoma have conceived and borne children, and yet neither the husband nor child have appeared to suffer in consequence. Alibert and others have likewise inoculated themselves with cancerous matter, and yet no contagious effect followed. Neither has this disease at any time been known to result from accidents incident to the examination either of the living or dead person.

Elementary Principles of Medicine.

In the first stage, the blood in cancer, as in tubercle, is normal in the quantity of fibrine; but in the second stage that substance is, for the most part, increased.

Such are the general laws of *carcinoma durum*, a disease which attacks principally the skin, the mammary glands, the lymphatic glands, the uterus and ovary, the epididymis, and testicle; also the mouth, tongue, and the alimentary canal from the pharynx to the rectum. Indeed, it seems limited to these parts, probably never affecting the viscera, the bones, or the muscles. It is now, however, necessary to describe more minutely the disease as it affects particular parts.

The *tongue* is sometimes the seat of this afflicting disease, which begins by the formation of a tumor, generally small, but hard or schirrous. This tumor, though long indolent, is, at the end of a greater or less length of time, the seat of severe lancinating pains, which are the precursors of its softening. The softening of the cancerous tumor at length takes place at its superficies, and the surface of the tongue ulcerates, and the edge of the ulcer is thickened and contracted, so that it is partly inverted and partly everted, while its base is hard, livid, or bleeding, and its secretions fœtid. The progress of the disease is still slow but unerring, and towards its close a large portion of the tongue is seen eaten away; the sub-lingual and sub-maxillary glands enlarged and involved in the cancerous formation, and the mouth generally in such a state that the patient is reduced to a spoon diet, swallows the cancerous ichor with his food, becomes greatly emaciated, and at last dies, perhaps of hæmorrhage, an object of loathing to himself and of pity and commiseration to others.

Cancer of the *tonsils and pharynx* is rare, although the tonsils are greatly liable to be simply hypertrophied and indurated. The disease usually begins with some difficulty of swallowing, when, if the amygdalæ be the seat of the disease, we find them enlarged; or, if the pharynx, we perceive a hard circumscribed thickened mass occupying a greater or less extent of the pharyngeal membrane. After a considerable period of indolent inaction, lancinating pains shoot through the part, followed by the peculiar ulceration, which extends in spite of every treatment, till at last the amygdalæ, the pharyngeal membrane, the soft palate, the posterior palatine bones, the glottis, larynx, base of the tongue, and the base of the skull, are perhaps all destroyed, and the dura mater exposed, and in this dreadful state the patient sinks, grateful for the relief death affords.

The *œsophagus* is more frequently affected with hard cancer than any of the preceding parts. The first symptoms are a difficulty of swallowing; and, if the probang be passed, an obstacle is felt. The disease, at first indolent, at length becomes active, and the patient falls. The morbid appearances which present themselves after death are—a more or less irregularly contracted state of the œsophagus, often extending for several inches, and sometimes reducing the diameter of this portion of the canal to the size of a common quill. Its walls are more or less irregularly thickened and indurated by the cancerous deposit, so that they may measure half an inch, an inch, and even more. The portion immediately above the strictured part is commonly pouchy, and sometimes to such an extent as to contain two and even three lbs. of aliment unable to force its way into the stomach. In general superficial ulceration has taken place at the

surface of the mucous membrane, and in a few cases the ulcer burrows in its usual manner, till at length it has perhaps perforated the larynx or trachea, and the patient falls from the aliment escaping into the bronchial tubes, or into the cavity of the chest. The quantity of food which reaches the stomach in these cases is extremely small, so that the patient's hunger is never satiated; and probably from this continued irritation the stomach presents some remarkable appearances; being, for the most part, small, thin, and of a dark, dirty, rusty brown colour; appearances similar to those found in the stomachs of destitute and famished patients. In some few instances, when the disease more principally affects the posterior portion of the œsophagus, the bodies of the vertebræ have become infiltrated with the cancerous matter, and Chardel mentions a case in which they were so softened that he was able to cut them with a knife.

Cancer of the *stomach* may embrace the whole extent of this organ, or any part of it. More usually, however, the affection is partial, and the parts most commonly affected are the orifices,—the frequency of the attack falling, 1st, on the pylorus, or the orifice connecting the stomach and duodenum; 2ndly, the cardiac orifice, or that which connects the stomach with the œsophagus; and lastly, on the body of the stomach.

When the orifices are the seat of cancer, they are constantly found contracted, but not closed, so that they appear to be in a state of permanent patency, the canal often not exceeding in diameter that of a quill. The walls of the orifices are often greatly thickened, the cancered portion varying from a few lines to a large tumor. In general, when the orifices are affected, the cancerous deposit stops suddenly at the commencement of the duodenum or œsophagus; but sometimes it extends a considerable distance along these canals. The pylorus being affected, the stomach is often much dilated.

When the body of the stomach is affected, the greater curvature is its most frequent seat. The cancerous formation is of varied thickness, as in other parts, but it does not form those large masses which are seen at the orifices; while, in extent, it varies from the size of an inch to the palm of the hand, and even sometimes embraces nearly the whole stomach. In these cases we find the muscular fibres in the opposite states either of hypertrophy or of atrophy; for, in some instances, they form fasciculi of great size, or as big as a wheaten straw; while, in other specimens, we are not able to discover in the midst of the thickened and indurated cellular tissue more than a few discoloured, attenuated fibres, separated by wide intervals. The cancerous degeneresence is not always limited to the stomach, but often extends to the glands situated on its edge; and then enlarged lymphatics can be traced sometimes to the mesentery, whose glands are also often enlarged.

In whatever part of the stomach the disease be seated, the patient often survives till the cancerous portion ulcerates, with its usual terrific characteristics, first superficially at its mucous surface, but afterwards perhaps penetrating between the lobules of the diseased structure till it reaches the peritoneum, which, rupturing, the patient dies of peritonitis. Sometimes the greater curvature of the stomach adheres to the colon, and then these parts may ulcerate into each other, so that the contents of the stomach may pass into the colon, or the contents of the colon into the stomach, and fæcal matter be thus thrown up by the mouth. Adhesions have also been seen formed between the stomach and the liver, or the stomach and the spleen; and those viscera have been extensively destroyed. Also, when the body of the stomach has been affected, the gastric artery or vein has become involved in the disease, has ulcerated and ruptured, and the patient has died from profuse hæmorrhage. Again, when the cardiac orifice has been the seat of the disease, that portion of the stomach has adhered to the diaphragm, and its contents have passed into the cavity of the chest. In general, in whatever portion of the stomach the disease he situated, the sound portion of the mucous membrane is usually found coated with a blackish or chocolate coloured mucus.

The *small intestines* are very rarely indeed found to be the seat of cancer. Chardel, however, mentions having seen them thickened and in a cancerous state throughout their whole extent. Much more frequently, however, only a small portion of the intestine is affected, as two or three inches, which becomes thickened and contracted so as hardly to admit the passage of a damson stone. This portion pursues the usual course, sometimes ulcerating before the death of the patient; and sometimes rupturing into the peritoneum, and destroying the patient.

The *colon* is more frequently affected with cancer than the small intestines; and although the cœcum and rectum, according to the usual law of the orifices being the usual seat of the disease, are the parts most frequently affected, yet it also often occurs in the more central parts of this intestine. This disease, as in the hollow organs generally, always occasions contraction; so that we constantly find the diameter of the gut reduced in these cases, and oftentimes so much so that a substance of the size of a pea can hardly pass. In the instance of the celebrated Talma, the intestine was contracted almost to obliteration. This obstruction to the course of the fæcal matter causes it to accumulate, and to such an extent that the superior portion often becomes enormously distended, almost to bursting. Many pounds weight, or many gallons by measure of fæcal matters have often been taken from it. The walls are thickened in the usual manner, and very frequently ulcerate at the mucous surface, and the ulcer, from the irritation to which it is exposed, often assumes a hideous character, ruptures the intestine, and the patient dies of peritonitis. The extent of the cancered portion is in general not more than a few inches, but Bouillaud has seen nearly the whole extent of the intestine schirrous.

When the *rectum* is the portion of the colon affected, the cancered part is often enormously thickened from the quantity of loose cellular tissue which surrounds it being filled with the cancerous deposit. The disease may begin at the anal extremity, or it may commence at the sphincters, or at two, three, or more inches above them. At whatever part, however, it begins, it has a tendency to spread upwards and downwards; and even all the left portion of the transverse colon has been involved in it. In proportion as the disease proceeds, the canal becomes contracted, so that the fæcal matters are either passed with difficulty in a fluid state, or, if solid, are as thin as a ribbon. The disease at length ulcerates; and the ulcer, if possible, is of a more than usually frightful character, having the hard inverted and everted edge, a hard fungoid bleeding base, and penetrating deeply, so as often to perforate the bladder in the male, or the bladder and uterus in the female, and from these causes

the fæcal matters may pass forwards, and the urinary secretions backwards. The patient seldom long survives the sad suffering this state of things produces.

The *bladder and ureters* are sometimes the exclusive seat of this disease, and the affection, though in a few instances general, is more commonly partial. Its characters are nearly the same in the incipient state as in the stomach, and the organ may be dilated or contracted, and its muscular coat atrophied or hypertrophied. When the disease ulcerates, it often involves the rectum or uterus, or both, so that the three cavities all communicate with each other. Cancer of the *ureters* is rarely primitive, but it frequently follows the cancerous affections of the bladder. In this case the inferior portion of these conduits is the part most commonly affected; and as this contracts, the part above is sometimes enormously dilated. Besides the ureters, the *prostate*, situated at the neck of the bladder, is frequently affected, and perhaps more so than the bladder itself. This gland, in its natural state, is about the size of a chesnut, but, when affected with cancer, it is greatly enlarged, oftentimes acquiring the size of an egg. The urethra of this portion contracts, and is now so winding or irregularly conformed, that the passage of the urine is always difficult, and sometimes suppressed, and the introduction of the catheter almost impossible.

Cancer of the *uterus* is one of the most common affections of that organ after the cessation of the menses. The neck is its most usual seat, and its posterior rather than its anterior lip. In the schirrous stage it is hard, knobbled, unequal, and its orifice irregular and half opened; while, if ulcerated, the ulcer is superficial, its edge rarely raised, or its base hard. In general the body of the uterus, a few lines above the cancered portion, is perfectly healthy, but the superior portion of the vagina usually participates in the disease. In a few instances the body of the uterus is alone affected with the cancerous deposit, and is alone the seat of ulceration. The patient sometimes dies after a very trifling ulcer has formed, sometimes not till after the almost total destruction of the uterus, and in a few instances not until the uterus, bladder, and rectum form one large ulcerous cavity.

Such is a short outline of the pathology of hard cancer, as it is generally seen by the physician.

Symptoms.—Hard cancer, in whatever organ situated, has three stages. In the first stage the part affected is hard, slowly enlarges, and has its functions impaired. At first all this goes on without pain; but as the disease proceeds, severe paroxysms of pain, or severe lancinating pains, are felt in the part, although at long intervals. The frequency of these pains increases; and the second stage is marked by a greater frequency and severity of the paroxysms, till they are at last induced by every action of the part, while in the intervals the pain is constant or nearly so, though bearable. In the last stage, or after ulceration has commenced, the pain is incessant, often amounts to agony, and is only terminated by death. The duration of each of these stages is very various. The first stage is always the longest, and may last several months, or even years. The second is always more rapid than the first, and the third than the second. The symptoms of all these stages are principally local, as the patient rarely suffers from fever except in a very few instances, and only then in the very last periods of life. He is, however, often greatly emaciated and enfeebled.

Cancer of the *tongue*, *mouth*, and *pharynx*, are demonstrable to sight, so that the existence of the disease is palpable. The symptoms are those which have been stated; or, first, the functions of the part are affected, and the patient finds some difficulty in swallowing; this is followed by lancinating pains, which become more constant; at length ulceration takes place, which spreads, annoying the patient by the fœtidness of its secretion, till he ultimately falls exhausted by the discharge, and worn down by the ceaseless agony. The frequency with which the tongue is attacked is happily trifling, or, according to M. Leroy d'Etiolles, of 633 men affected with cancer only 18 had that disease of the tongue, while, of 2148 cancerous women, only 2 suffered in that organ.

Cancer of the *œsophagus* being out of sight, its existence is more difficult to determine. The first stage of this malady is marked by some difficulty in deglutition, followed at long intervals by occasional severe paroxysms of pain or colic, often referred to the stomach. The disease proceeds, the difficulty of swallowing augments, the paroxysms are more severe, and some pain or uneasiness is felt in the intervals. The patient is now constantly spitting a thick viscid phlegm, and in the last stage he throws up his food, and at intervals after eating, which are supposed to vary according as the cancerous stricture is situated high up or low down in the œsophagus. When, for instance, the food is returned as soon as swallowed, the obstruction must be high up; if lower down, a longer period elapses; and when the lowest portion, or towards the cardiac orifice is affected, the matters swallowed often remain for six, twelve, or even twenty-four hours, when they are thrown up unchanged, or only mixed with mucosities, the pouchy state of the superior portion of the œsophagus enabling it to retain a large dinner. As little passes into the stomach, the patient eats with great appetite; but notwithstanding this large supply, he becomes daily more and more emaciated, and at length dies with a feeble slow pulse, and a collected mind, worn to the bone by hunger and by frequent attacks of pain.

The first stage of cancer of the *stomach* is marked by frequent attacks of indigestion, and occasional paroxysms of gastric colic. The patient also loses flesh; his countenance becomes sallow, and he is evidently out of health.

In the second stage the pain recurs more frequently; pressure on the epigastrium increases it; and the suffering of the patient after eating is so great, that he is led greatly to diminish his usual quantity of food, and to lower its quality. At length digestion terminates, when the pain ceases for a time and he is once more at ease. In the midst of this deranged state of digestion, the appetite is good, often greatly increased, and there is a strange contest between the desire of eating and the terror the patient feels at indulging his appetite. His bowels are constipated, his tongue clean, his pulse quiet, and he is without fever, but his emaciation denotes the inward disease under which labours.

The last stage, or when ulceration of the stomach has taken place, is denoted by the purulent nature of the matters vomited, and also by the fæcal dejections being insupportably fœtid. Under these circumstances the strength of the patient is rapidly exhausted, some delirium ensues, and the patient dies either with or without diarrhœa. It is singular that death is often pre-

ceded by an entire cessation of suffering, as if the stomach had lost all power of re-action. In other cases vomiting of blood closes the scene, some large vessel of the stomach having ruptured; or else the patient dies of peritonitis, the ulcer having penetrated the cavity of the abdomen.

It is generally supposed that when the cardiac orifice is affected, pain immediately follows the effort of swallowing, and that vomiting takes place a few minutes afterwards. Again, if the body of the stomach be affected, that there is no difficulty in swallowing, while pain follows immediately from fruitless efforts at digestion, and vomiting some time afterwards. Lastly, that when the pyloric orifice is affected, that there is no difficulty in swallowing; that digestion proceeds, and that the pain and vomiting are delayed till the chyme attempts to pass into the duodenum. These phenomena, it must be admitted, are sometimes observed; but the difference of nervous sensibility is so great in different individuals that the rule cannot be relied on.

Cancer of the *small intestines* is so rare that few cases have been recorded of it. In a case which occurred some years ago in St. Thomas's Hospital the patient complained of great pain in the region of the liver, which was relieved by pressure, and of so severe a character that it was mistaken for the passage of a gall-stone. In three or four days the pain subsided, and the man shortly afterwards left the house. He continued well for about a twelvemonth, when he returned a second time to the hospital with exactly the same symptoms. The paroxysms, however, instead of subsiding, returned daily for many weeks. Indeed he had no ease unless he was constantly purged, and with these symptoms he shortly died.

When the *large intestines* are the seat of this form of cancer, the symptoms vary in some degree according to the seat of the disease. If the cœcum be the cancered portion, the symptoms in a great measure resemble those which have just been mentioned. When, however, the more central parts of the colon are affected, the opportunity for the accumulation of fæcal matter behind the stricture is greatly increased, and the patient, though he has longer intervals of ease, has severer attacks of pain in the bowels, aggravated by long constipation, having at first only three or four stools a week, then once a week, or once a fortnight; and Dr. Baillie gives a case in which nearly fifteen weeks elapsed without any evacuation. In this case the colon was so distended, that its transverse diameter measured above six inches; it contained a large quantity of fæcal matter, which, notwithstanding the long time it had been retained, was of a healthy character.

If the cancer is seated in the rectal portion of the colon, the first symptom is often an irritable state of the bladder; and this is followed by attacks of constipation and colic as severe, perhaps, as in the former case. If ulceration takes place, the devastation is often terrible, a communication being often formed between the rectum and bladder in the male, or between the bladder and uterus and the vagina in the female, and the patient dies from intense suffering, little relieved by our most powerful medicines.

The symptoms of cancer of the *bladder* or *prostate* are, pain and irritability of that organ, an irresistible desire to pass urine, and which, when effected, is accompanied with great pain. The urine, also, is loaded with mucus, and this secretion otherwise deranged. The prostate may be determined to be affected by the difficulty of passing the catheter, and by its increased size, causing it to project into the rectum.

The cancerous affections of the *uterus* are lumbar pains, pain on pressure above the pubis, difficulty of making water, and a fœtid discharge, mixed with blood. This disease may be made manifest to sight by means of the speculum. The examination by "*le toucher*," is liable to endless errors.

Diagnosis.—Cancerous affections may be similated by many nervous disorders, and also by chronic inflammation of the respective parts; but the long continuance of the symptoms, their gradual augmentation, the severe pain which admits of no permanent relief, together with the loss of health and slow emaciation of the party, at last give a moral conviction that it must be cancer, and no other disorder.

Prognosis.—Cancer, though long latent and its course slow, pursues its destructive progress unimpeded, and in no instance does amendment or a return to health await the patient, who ultimately falls an inevitable victim to his complaint.

Treatment.—No remedy has yet been found which can in any degree be considered curative of cancer, and the efforts of the practitioner are consequently limited to relieving symptoms, and to the adoption of such palliative measures as may prolong life.

In whatever part the disease may be situated, one great rule is to endeavour to restore the healthy functions of that part by purgatives or other medicines, and to alleviate the distressing pains the patient endures by opiates. These remedies are for a time successful, but make no impression on the disease, which silently proceeds, and the patient finally limits himself altogether to opiates The quantity of opium or other narcotic which the patient has been known to take is sometimes enormous, as five, ten, fifteen, or twenty grains of opium at a dose, or a proportionate quantity of hyoscyamus or of conium, exhibited three, four, or more times in the twenty-four hours. Dr. Powel used, however, to mention instances in which these large doses had been given with impunity for a long time, when most unexpectedly the patient had died narcotized, and apparently from merely changing the parcel of the medicine, either from some great difference in its strength, or else from its possessing qualities differing from those of the original parcel. He therefore always advised that, on having recourse to a new parcel, the dose should be reduced. But although these large doses have occasionally been given, yet it may be questioned whether they are not more hurtful than beneficial; for usually they produce headache, delirium, loss of appetite, and narcotism, so that the patient is only the more rapidly exhausted. In general, therefore, the patient does better under moderate doses of opiates, as one or two grains of opium, or its equivalent of morphine, or other narcotic, every eight, six, or four hours, than when more excessive doses are given,—a larger dose producing headache and much cerebral disturbance, without in any sensible degree mitigating the sufferings of the patient.

When the disease is seated in the colon, the quantity of purgative medicine necessary to produce a motion is often quite extraordinary. Dr. Baillie gave to a man labouring under this complaint five grains of calomel and ten grains of gamboge, but without producing even an attempt at evacuation by stool. This was followed up by a scruple of calomel and half a drachm of jalap, but even this was equally unsuccessful. Two

drachms of gamboge were thrown up and quickly evacuated, but without being accompanied by any fæcal matter. On the following day another enema, containing three drachms of gamboge, was administered, but without any greater effect. Tobacco smoke was also injected in vain; the patient was then directed to take four grains of elaterium, but this made him sick without producing any evacuation by stool, and he afterwards swallowed three ounces of quicksilver, but without any result. As adjuvantia, electric sparks were sent through the abdomen, cold water dashed on the feet, a candle was passed up the rectum, but all were equally vain.

When the stomach is so irritable that it rejects everything, it is our duty to support the patient by nutritive injections, as of strong broth, egg-flip, of sago, or other fluid substances. It has been attempted to impart strength to the patient by means of milk baths, or baths of strong broths; but the skin has not any sufficient power of absorption, so that it has been found the heat of the bath has exhausted the patient in a far greater ratio than its nutriment supported him.

As a general principle, diet has no influence over the course of the disease, so that whatever agrees with the patient may be safely indulged in.

Of Carcinoma Molle, or Soft Cancer.

Soft cancer differs from hard cancer in affecting organs rather than tissues, in being generally deposited in masses, and but rarely infiltrated. It differs also from it by the products of the softened or second stage being most profuse, and by its course being much shorter, this disease being generally terminated in a few months.

Remote Causes.—The remote causes of this affection are equally inexplicable with those of hard cancer, but the peculiar disposition once formed, changes of temperature and accidental injuries are its most usual exciting causes.

Predisposing Causes.—Hard cancer for the most part affects persons in the decline of life, but soft cancer is most common in its earlier period. Thus soft cancer of the eye, and of the jaw, is often seen in children. While soft cancer of the long bones, of the liver, of the lungs, of the peritoneum, &c., is most common in adult age, or from 25 to 40. This disease affects both sexes, and perhaps in nearly equal proportions.

Pathology.—Soft cancer is generally deposited in masses, but it may be infiltrated; the former is the more common form, the latter rare. In whichever form, however, deposited, it has two stages, or a stage of induration and a stage of softening. If we examine a soft carcinomatous tumor in the first stage, we find it composed, as in hard cancer, of cellular tissue and a morbid growth or substance. The cellular tissue is of various densities, often extremely fine, and then again of considerable consistency and tenacity, and in either case radiating through the tumor and dividing its lobules. The morbid substance or growth is of many degrees of hardness, or varies from lard to cartilage, but is generally softer than in the hard cancer; it is also of a bluish semi-transparent whiteness. The duration of this stage is from a few weeks to two, three, or four months, and only in a few instances does it exceed that latter period.

The first stage passed, the process of softening, or of *ramollissement*, takes place. The first evidence of this, according to Lobstein, is, that on cutting into the tumor, and passing the handle of the scalpel over the divided surface, a milky white substance is expressed. As the disease proceeds the parenchymatous substance is changed into the consistence of soft cerebral matter, or of thickened pus; it is consequently opaque, and varies in colour from white to red, and even black. These variations of colour appear to be owing to the different quantities of blood, or of melanic matter which are effused, and with which the cancerous matter is commixed. When bloodless, and therefore white, the product is so peculiar that it has been termed cerebriform, and, when mixed with blood, medullary sarcoma, fungus hæmatoides, and many other terms, according to the different quantities of that fluid effused, which is often so abundant that the cyst or cavity at length contains little else than fibrine.

The process of softening seems to commence indifferently in every part of the tumor, as at its centre, or towards its circumference; and if the tumor communicates externally the quantity of softened matter discharged often amounts to many ounces in the course of the day. This profuseness of discharge appears to be owing to the great vascularity of the tumor; for although in the hard stage only a few blood-vessels, with coats of great tenuity and delicacy, can be traced between the lobules; yet, in the softened state, a successful injection shows them to be made up almost entirely of blood-vessels.

The duration of the second stage is generally a few weeks, and very rarely a few months. It appears to be a law, however, that anything that greatly irritates the part accelerates the process of softening. Thus, if a cancerous limb or tumor be amputated, the cancerous matter primarily deposited in a hardened state is, subsequent to the operation, deposited in a softened condition, no previous hard stage existing. It would appear, also, that in a very few instances it is deposited in a softened state, independently of any operation; and there is a specimen in the museum of St. Thomas's Hospital of infiltrated soft cancer into the sub-mucous cellular tissue of the small intestines, which appears to be of this description. It was taken from a young man, who had carcinoma molle of several other organs, and in none of which were the tumors softened. The minute organic structure of this form of disease, in its schirrous state, is probably not dissimilar to that of hard cancer, and of its vital organic character there can be no doubt. Lobstein conceives that chemical analysis has shown the soft cancerous tumor in the first stage to be composed principally of gelatine, while in the second stage albumen is the principal ingredient. There is no ground whatever for conceiving this disease to possess any contagious property.

There is scarcely any organ or tissue in which soft cancer has not been found, and by some pathologists the frequency of its occurrence is supposed to be in the following order:—the liver, epiploica, the mesentery, the lymphatic glands, the brain and nerves, the spleen, the testicles, the uterus and ovaries, the eye, the bones, the heart, and lastly the blood-vessels. It has been stated that soft cancerous matter is far more frequently deposited in masses than infiltrated into these parts. In general there is only one tumor; but there may be, as is often seen in the liver, three or four, and in some cases they are extremely numerous. Dupuytren has met with a carcinomatous heart which contained more than 600. In size they commonly vary from a millet-seed

to a large egg; but when they form in loose cellular tissue, as between the folds of the mesentery or of the epiploica, or in the substance of the lungs, they have been known to weigh 20, 30, 40, and even more pounds. These tumors may also be encysted or non-encysted.

One of the most constant features of this disease, and which distinguishes it from hard cancer, is, that it often appears in many organs or tissues at the same time in the same patient. Thus it has been met with in the coats of the bladder, in the liver, and in the lungs of the same party. Another law of this disease is, that it has a great tendency to be reproduced after an operation for its extirpation. This reproduction may take place either at the part operated on, or else in some organ or tissue distant from the primary seat of the disease. A cancerous tumor, for instance, having been removed from the armpit, others soon formed under the skin of the thigh and of the neck. In another case, a cancerous testicle having been removed, a similar tumor formed in the abdomen, and many small ones were found in the lungs and in the liver; circumstances which seem to demonstrate that soft cancer is a constitutional and not a mere local disease. These are the general laws of this disease; the pathology of its more particular instances are as follows:—

The scalp, the diploï of the skull, or the surface of the dura mater, may be each exclusively the seat of soft cancer; but more commonly all these three parts are simultaneously or consecutively affected; for if the disease begins in the scalp it often extends to the cranial bones, and from the cranial bones to the dura mater, and *vice versâ*. When the disease begins in the scalp the masses are often numerous, 20, 30, or more tumors being sometimes scattered over it. When, however, they form on the dura mater they seldom exceed two or three. In either of these cases the bone may be healthy, but more usually its cancellous structure is loaded with cancerous matter, interspersed with spiculæ of bone, the substance of the bone being soft and spongy.

Soft cancer of the *brain* is occasionally, but not often, met with. Andral has collected 43 cases, most of them recorded in different medical works, to which he has added some few observed by himself. Of these 43 cases the cancerous tumor was situated in 31 in the hemispheres, in 3 in the pituitary gland, in 5 in the cerebellum, in 1 in the mesocephalus, and in 3 in the spinal cord.

In cancer of the brain the patient generally falls while the disease is yet in the first stage, and before softening has begun. The size of the tumor varies greatly; for in some cases it is scarcely bigger than a nut, while in others a large portion of an entire hemisphere has been converted into cancer. The number of the cancerous tumors also greatly varies; in general there is only one, while in some cases there are many, occupying different parts of the brain. Around the cancerous masses the substance of the brain is found sometimes healthy and sometimes softened, while serum for the most part is found effused into the cavity of the arachnoid.

Among the forty-three cases mentioned by Andral, there were ten in which cancer affected other organs as well as the brain. In some of these instances the affection of the brain was primary, but in others it was consecutive to that of other organs. In one instance it appeared to follow the removal of a cancerous testicle, the patient up to that period not having shown any symptoms of disease in any other part of the body; but shortly afterwards he wasted and died, and on examination, enormous cancerous masses were found in the mesenteric glands, in the liver, spleen, lung, and brain.

Soft cancerous tumors form not only within the cranium, but also within the *rachidian canal*. Lecat gives a case in which a carcinomatous tumor destroyed the spinous processes of the four first lumbar vertebræ. Olivier speaks of having met with many examples of cancerous tumors developed in the rachidian, dura mater, and also between the pia mater and arachnoid. In one the tumor weighed no less than eight ounces; and by its pressure, the fifth, sixth, seventh, and eighth dorsal vertebræ were absorbed, so that it presented itself externally. The same authority also gives the following instance of carcinomatous affection of the *substance* of the *cord*. The patient was a widow, aged thirty-six, who died after two years' illness, and on opening the spinal canal, a fungous growth was seen covering the whole anterior surface of the cord from the sixth cervical to the third dorsal vertebra; it was under the arachnoid, and appeared to be incorporated with the substance of the cord.

Soft cancerous tumors sometimes form in the *substance* of the *nerves*, and sometimes on their *neurilema* or coat. Sir Everard Home met with one of these tumors in the musculo-cutaneous nerve, of the size of a small pullet's egg; M. Dubois, one on the median nerve; and Dupuytren, one on the posterior tibial nerve; while in another case he found the trifacial nerve transformed into a cerehriform substance.

Soft cancerous matter is sometimes infiltrated into the tissues of the eyelid—its seat the free edge, or else the commissures of the eyelid. When the external commissure is affected, the disease often begins with a painful fissure with a grey base; an ulcer at length forms, which spreads with edges inverted and everted, often destroying the whole of the eyelid and other portions of the face. Cancer of the internal commissure begins generally in the caruncula lachrymalis, which is swollen, hard, schirrous; this at length ulcerates, and either so compresses or involves the lachrymal duct, that it is accompanied by a continual discharge of tears, or a "watery eye."

The cancerous deposit may be *infiltrated* or formed into *tumors* in the *eye*. This disease sometimes begins in the conjunctiva, which becomes fungoid, hardened, and disorganized. In other cases it takes place among the laminæ of the transparent cornea, which ulcerate, and the ulcer having an elevated edge and a schirrous base, invades the surrounding parts. Again, the cancerous formation may affect the deeper-seated membranes, and more especially the retina and choroid membrane; and in these cases a tumor forms, which thrusts the eye out of the orbit, displaces the vitreous humour, dislocates the crystalline lens, and impairs the action of the iris, and these parts afterwards ulcerating, the sight is shortly destroyed.

Soft cancerous tumors occasionally form in the cellular tissue of the *orbit*. The majority of these tumors are of rapid growth, of a soft medullary structure, and are quickly reproduced if removed. They are of such magnitude that in most cases the eye protrudes in a most unsightly manner, while vision is impaired or wholly lost by the pressure and extension of the optic

nerve. But although the eye is often displaced to a great extent, yet vision is sometimes preserved. These malignant tumors are most frequently met with in childhood, though they may occur at all periods of life. In the majority of cases similar tumors co-exist within the cranium along the optic nerves, or in their tract behind the commissure, extending to the optic lobes, and even to the cerebellum.

The different structures of the *face* and *mouth* are also often the seat either of soft cancerous infiltration or of cancerous tumors. Thus we often find intractable infiltrated ulcers of this description of the integuments of the nose, of the cheek, and of the mouth; or, of 633 cases of men affected with cancer, 165 had cancer of the lip, while of 2148 women, only 54 had this affection of the lip, a difference which M. Leroy d'Etiolles conceives results from the greater use of the pipe among men, and especially of the short broken pipe, which the French term "*brûle gueule.*" The cavities of the facial structure are also the seat of cancerous tumors, which give rise to great deformities. These growths often commence in the sinuses connected with the cavity of the nose, show themselves from the nostrils, protrude through the orbit, and get into the mouth behind the palate, through the tuberous processes of the superior maxillary bone, or project through the alveolar processes. Sometimes, though rarely, these tumors form in the frontal sinuses, or sprout from the antrum. The parotid gland is also occasionally the seat of this affection, and is the more formidable from its connexion with the carotid artery.

The alimentary canal is occasionally the seat of soft cancerous infiltration, or else of tumor. These tumors have often been found in the *stomach.* A woman, previously in perfect health, died at the Hôpital Cochin of a fractured thigh; she was opened, and four cancerous tumors were found at the posterior face of the stomach. Andral also met with a large cancerous tumor in the stomach of a young man aged twenty-two. In the Museum of St. Thomas's Hospital there are two specimens of these large cancerous tumors of the stomach, which occurred in the practice of Dr. Williams. The patient generally dies before ulceration takes place, but should he survive that result, the ulcer is usually of a most irregular and hideous character.

The soft cancer does not appear to exist nearly so frequently in the intestines as in the stomach; and, as has been stated, there is an almost unique specimen of infiltrated soft cancer in the coats of the small intestines in the museum in St. Thomas's Hospital.

Soft cancer of the *liver* is by no means unfrequent, yet Cayol conceives that previous to 1833, when he described it, no account of it existed. The pathological phenomena of this disease are, that on opening a patient that has died of soft cancer of the liver, we observe the surface of that organ marked with one or more slightly projecting tumors covered by the peritoneal coat. These are white, opaque, and slightly depressed in the centre. When the liver is cut into we often find others less superficial; so that their number varies perhaps from one to five or six, or even more, while in size they vary from a pea to an orange. In some instances the liver appears infiltrated with this substance, so that it occupies three-fourths of a lobe.

The patient usually falls while the tumors are yet in the schirrous stage, or semi-transparent, radiated, and of a moderate hardness. In the greater number of cases they are enveloped in cellular tissue, and can readily be dissected out with the handle of the scalpel, when a perfectly smooth cavity is left; but in other instances there is unquestionably continuity of tissue between the liver and these tumors. If the patient survives this stage, the first step towards softening is the appearance of a few blood-vessels penetrating between the lobules, and perhaps a slight effusion of blood in the centre of the tumor. This is followed by a gradual conversion of the cancerous matter into a cerebriform substance, and which proceeds till the whole is so broken down as to form a sort of abscess, which may burst into the peritoneal cavity, into the stomach, the duodenum, or colon. It is singular, says Cayol, that the secretion of bile is little interrupted, even in those cases in which large portions of the liver are affected, for the bile in the gall-bladder is not sensibly altered either as to quality or quantity. The substance of the liver also around the tumor is healthy. The jaundice, which sometimes, but by no means constantly, accompanies this affection, Cayol considers to depend on the pressure made by the tumors on the gall-ducts. Besides cancer of the liver, Bouilland has seen a schirrous state of the gall-bladder, and he also mentions having met with a cancerous tumor, of the size of an almond, at the embouchure of the hepatic veins at their junction with the cava.

Soft cancer of the *pancreas* is by no means common; for although many patients who die of cancer of the stomach or liver have cancerous masses more or less considerable in the neighbourhood of the pancreas, yet when the latter viscus is examined it is generally found without alteration. Primary affection of the pancreas is still more rare; and only a few cases have been met with out of many thousand bodies examined. The celebrated President, De Thou, however, is supposed to have died of this disease. Dr. Bright, in the 18th volume of the *Med. Chir. Transact.* has given some instances of malignant disease of this viscus. Mr. Mayo has also given a case in which the pancreas was considerably enlarged, and of nearly cartilaginous hardness, except some spots, which were soft, with the appearance of medullary sarcoma. A case also recently occurred, in which the pancreas, besides being enlarged, was softened and red in consequence of the large quantity of blood which had been effused.

The soft cancer of the *spleen* is rare, and its characters not well understood. Two cases, however, lately died in St. Thomas's Hospital with dropsy and enlarged spleen, and on examining them a reddish broken-down tumor was discovered in each of their spleens, and which appeared to be soft cancer, modified perhaps by tissue.

Soft cancer of the kidneys is more common, and in the hard stage presents all the characters which have been remarked as occurring in the liver. But the kidney acquires a greater size, and has been said to weigh as much as 40 lb. when thus diseased. One case is given, in which the vena cava was obliterated by its pressure. When the disease passes to the softened stage, the product varies greatly in character; sometimes the tumor being converted into a white cerebriform matter, and sometimes filled with pure fibrine—differences which are probably owing to differences in the quantity of blood effused.

The *bladder* is sometimes the seat of soft cancer, and which may be infiltrated or formed into masses. More commonly it assumes the form of fungous vegeta-

tions projecting into the cavity of this viscus, and sometimes entirely filling it. A case of this description occurred to Bouillaud, at La Charité, in 1828. The tumor was as large as the fist, and resembled a cauliflower excrescence, and filled the entire cavity of the bladder; and a similar but less formidable case occurred recently at St. Thomas's Hospital.

The *uterus*, like other organs, is occasionally the seat of this disease. It may be infiltrated or formed into masses, but the former is the most common. In the schirrous stage, these tumors are not so transparent as those of the liver, but more resemble lard, and generally occupy the body of the uterus. They are of various sizes, or from a pea to a small egg. When infiltrated it is most generally the neck of the uterus which is diseased, and the ulcer which follows has generally a soft base and a smooth edge.

Bayle and Cayol question the existence of soft cancer of *the ovary;* but in women of a "certain age," says Bouillaud, this disease is not rare, and he gives a case in which the two ovaries were so enlarged as to meet; the left ovary being the size of an ordinary liver, and the right that of a fœtal head. M. Maingauli has communicated to the Académie Royale de Médecine, a case in which the ovary thus enlarged weighed 60 lb.

A more common seat of soft cancer is the folds of the *mesentery*, and the tumors which here form are of the largest magnitude—the cancerous formation sometimes occupying the whole of the abdomen, so that the party, if a female, is often larger than at the most advanced periods of pregnancy; or, if a male, has the appearance of one labouring under ascites. These tumors present no novel appearance; they are lobulated, and extremely vascular. The patient usually falls before they soften, but occasionally he survives till after that period, when the different lobules may be seen in every stage and degree of hardness and of softening. In most cases, however, these tumors form adhesions to the walls of the abdomen, and in a few instances ulcerate, so that the tumor softens and bursts externally, when the discharge is generally enormous, and rapidly destroys the patient. It is remarkable that, on examining the bodies of patients who have died in this state, we often find considerable quantities of the softened cerebral matter in the larger blood vessels, and also in the cavities of the heart.

Soft cancer of *the lung* was perhaps first pointed out by Bayle. It presents itself under two different forms—of masses and of infiltration, and may be complicated with tubercle or other disease of the lung. Bouillaud much over-estimates the frequency of this disease when he states, that out of 200 cases he found four of pulmonary cancer. He gives the case of a young girl with cancer of the lachrymal duct and carcinomatous polypus of the nose, in whom the superior lobe of the lung was transformed into one compact lardaceous mass, of a yellowish white, and without a trace of blood-vessels or nerves. It was not softened, and some large bronchial tubes not obliterated could be traced through it. In another case, the entire lung was converted into a cancerous mass, in the substance of which some pulmonary vesicles could be distinguished, though atrophied. The bronchial glands are also occasionally the seat of this affection.

Cancerous masses of greater or less size are sometimes developed in the subjacent *pleural cellular tissue*. In a case given by Velpeau, four cancerous masses existed between the ribs and the pleura. In a case also that recently died in St. Thomas's, a mass of serous cysts, as big as a large apple, and adherent to the false ribs, had become the seat of cancerous deposit. It is in the cellular tissue of the mediastinum, however, that cancerous masses more often form, and sometimes so large as to compress the aorta, vena cava, pulmonary artery, or phrenic nerves. Dalmas has seen the superior vena cava obliterated from this cause. In other cases they cause absorption of the bones of the sternum, and form a projection of considerable extent under the integuments. Bouillaud has seen one which was mistaken for aneurism of the aorta.

Soft cancer of the *heart* appears to have been first described by M. Carcassonne, in the *Mémoires de la Société Royale de Médecine*, in 1777-8, and it has since been seen by most pathologists. In one case given by Laënnec, there were several cancerous masses about the size of a nut in the muscular substance of the ventricles; while in another it was deposited in layers one to four lines thick along the coronary vessels, between the pericardium and the heart. Also in a case by Trélat, the walls of the right ventricle were an inch and a half thick from infiltration of cancerous matter, while the septum auriculi was transformed into a schirrous mass an inch and a half thick. The septum ventriculi was likewise in a cancerous state. Velpeau also gives a case in which the walls of the heart contained about a dozen cancerous masses of various sizes, the biggest being as large as a pigeon's egg. Sometimes the *pericardium* has been found involved in the disease. Cancer of the heart has rarely been seen, except when similar disease has existed in other parts of the body.

Cancer *mammarum* rarely attacks the male, but is almost peculiar to the female. It is scarcely ever seen before 20, sometimes between 20 and 30, more frequently between 30 and 40, but is most common from 40 to 55. From the age of 60 to extreme old age it becomes more and more rare. Its usual course is as follows:—

A woman, on touching her breast, discovers a small tumor or hardness, which causes her so little inconvenience that she neglects it. The hardness augments and the tumor increases, and though at first perhaps not bigger than a nut, reaches the size of a duck's egg. At first it was round, circumscribed, and moveable under the finger, but at length its surface becomes unequal and knotted, as well as adherent to the skin or muscle. It may still, however, be handled without pain or suffering, but is the occasional seat of lancinating pain. The disease increases, the surrounding cellular tissue becomes infiltrated with the cancerous deposit, and the lymphatic glands of the armpit become enlarged. The tumor is at length salient; the skin covering it red or livid; the nipple sunk and depressed; and, at last, the skin cracks. This crack or chap enlarges into an ulcer, which burrows in every direction, whose edges are thickened and everted, and which discharges a copious and fœtid sanies, and at length frequent hæmorrhage takes place. The disease pursues an unmitigated course; and at last the patient, worn out by incessant suffering, and exhausted by a constant discharge, gladly resigns a life so long embittered. Such is the more ordinary course of cancer of the mammæ; but this disease has endless varieties, both in its progress and in the nature of its discharge, which our limits prevent us from describing.

Symptoms.—Soft cancer, when the tumor has space to enlarge, forms and runs its course, with a few exceptions, without pain. In the close cavities, however, as the brain, the patient's sufferings are often severe from the pressure the tumor produces on the nerves. Cancer of the mammæ and testicle is of a more mixed character, and the latter stages of the disease are often accompanied with great suffering.

When cancerous tumors form in the *scalp*, the patient suffers no pain, but ulceration at length takes place, and the patient falls from hectic and exhaustion.

Soft cancer of the *brain* has no characteristic symptom. The lesions of the intellect are by no means constant or uniform. Indeed in by far the greater number of cases the intellect has continued unimpaired. In other instances, however, the mind has become obtuse; the memory impaired; and this has been followed by delirium, insanity, or epilepsy. Lesions of motion are also not more constant, and sometimes are altogether wanting. When they do exist, the result is a slow-coming palsy, affecting one or more limbs, as an arm or a leg; or the patient may be paraplegic or hæmiplegic, with affection of the bladder. The palsy likewise may be complete or partial, confined to the extensor or flexor muscles, and therefore accompanied by contraction.

Lesions of sensation are likewise by no means constant; thus headache, although frequent, is not present in every case, and when present offers the greatest difference in intensity, being sometimes slight, so as hardly to be remarked, and at others so severe as to form the prominent feature of the disease. Its character also varies, being sometimes dull, and sometimes lancinating; sometimes constant, and sometimes intermitting. Neither does it always designate the seat of the disease, being sometimes general when the disease is very limited. The pressure on the brain likewise causes the pain often to be reflected. Thus, in some persons the pain is only felt in the arm or trunk, while others suffer from a singular sensibility of every part of the cutaneous tissue, so that the slightest touch is followed by the most excruciating agony, while in others the patient is annoyed by the most insupportable itching.

The functions of the senses have in some instances been impaired, whether the nerves have or have not participated in the cancerous affection. Thus some persons suffer a gradual loss of sight. In Dr. Wollaston's case, vision was so singularly affected that he was able to see only the latter halves of words. In another case the patient became so deaf and so blind that the only mode of conversing with him was by the fingers. While Andral mentions a girl who lost the use of every sense, as also of motion, although her intellect remained perfect.

It frequently happens that the general health is good till a very late period; but in other cases the patient is troubled with frequent vomiting, constipation, and retention or else incapability of holding his water.

When cancer forms among the meninges of the brain, as long as the cranium is imperforate, the symptoms are the same as those of the brain. When at length, however, the cancerous tumor has perforated the walls of the cranium, the pain perhaps ceases, but ulceration takes place, and death soon follows.

Nothing is more variable than the duration of cancer of the brain. Sometimes death takes place in a few months, while in others years elapse before the fatal catastrophe. In either case the patient may fall seized with convulsions, epilepsy, or coma, or else die exhausted from ulceration of the nates, sacrum, &c.

Cancer of the *vertebral column* is generally marked by paraplegia, incontinence of urine, numbness of the lower extremities, sloughing of the nates, and death. The palsy which results may be either complete or accompanied by contraction. In one woman, aged 52, during the period of four months, her limbs could not be flexed without producing most atrocious pain. At length her legs became contracted, and to such a degree, that the heels were in contact with the glutei muscles, and the knees with the chest, and extension was now as painful as flexure had been before. In some few instances, as long as the palsy is incomplete, the pain in the back is long continued and extremely severe, and accompanied by convulsive twitchings, which do not subside till the palsy is complete. The duration of this affection varies from a few months to two or three years.

Soft cancer also often forms superficially in the *subcutaneous tissue*, and is usually accompanied with similar forms of this disease in other parts of the body. The tumor thus formed, if removed by an operation, is almost always re-produced by a more rapid growth, and in a more softened state, and consequently runs a much quicker course than the original tumor. Soft cancerous matter is also frequently deposited in large masses, as well as infiltrated, into the *adipose* and *cellular membrane*, and also among the *muscles* and in the substance of the *bones*. Whenever the fungus comes in contact with the muscles, says Mr. Hey, they lose their natural colour and become brown. They also lose their fibrous appearance, and cannot in every part be distinguished from adipose membrane. The fungus as it increases in bulk does not render the integuments uniformly thin, as in the case of an abscess; but they continue to feel thick as usual, over the tumor which forms beneath them, and which at length ruptures them. When the bone is the seat of this affection it greatly enlarges, especially its cancellous structure, which becomes filled with cancerous matter, and, as the disease proceeds, the whole limb becomes more or less infiltrated with it.

Soft cancer of the *testicle* is not unusual, and its schirrous stage has no peculiarity. In the second stage the product is either a soft colourless cerebriform matter or a cerebriform matter streaked with blood, or else it may be the seat of more considerable hæmorrhage. The cord often participates in the affection, adheres to the pubis, and fixes the testicle there. The lymphatics and their glands often undergo the same degenerescence, and by their pressure have obliterated the large vessels with which they lie so nearly in contact. In the last stage the tunica albuginea ruptures, ulceration follows, and fungous growths springing from its base give rise to a foul fœtid discharge, accompanied by frequent hæmorrhage. The cancerous testicle has been seen to weigh seven pounds.

On examining the bodies of those who have died of soft cancer in its softened state, it is not unusual to find cerebriform matter in considerable quantity in the veins, and it may often be traced even into the cavities of the heart.

Soft Cancer of the Periosteum.—Mr. Frogly has given two cases of a whitish elastic hard tumor of

the thigh resembling cartilage, but rather more transparent, and of considerable size, the diameter of one measuring $5\frac{1}{2}$ inches. On cutting into it it was found to consist of numerous cysts containing several pints of a yellow tenacious honey-like fluid, and was evidently a serous cyst which had undergone cancerous degeneration. The second case was similar.

The cancerous tumors formed on the *nervous trunks* are ordinarily moveable, but very painful when touched, so that the patient for the most part willingly submits to an operation. If the operation be performed, as a portion of the nerve must be excised, the patient, as a consequence, necessarily suffers from a greater or less degree of palsy and insensibility of the parts to which the nerve is distributed.

Soft cancer of the *palate*, *mouth*, and *face* are seldom accompanied by pain, unless it results from pressure made on the surrounding parts.

In the stomach large cancerous tumors often exist without the slightest pain. A man, about 50, was admitted into St. Thomas's Hospital: he was greatly emaciated, and evidently out of health; but he ate heartily, slept well, had a quiet pulse, and made no complaint of sickness. A few hours before his death, however, he did vomit. On examining this patient a soft cancerous tumor, as big as the fist, was found in the stomach. In another emaciated patient, admitted for dropsy, there was no sickness, nor any complaint of pain; after death, however, a similar tumor was found in the stomach of this man. In another case, in which there was cancerous infiltration in the coats of the *small intestine*, none of the functions of the bowels were impaired.

The *pancreas*, from its close texture, perhaps gives more evidence of this affection; and the symptoms are, some pain in the epigastrium, vomiting, and headache, with great emaciation. Mr. Mayo, however, gives a case in which the patient took a good deal of food, and complained of nothing except a pulsative pain of the ear. The symptoms are consequently not constant; and unless a tumor can be felt, the diagnosis of this disease is still very imperfect.

Cancer of the *liver*, according to the general rule, is often void of pain. A patient was admitted into St. Thomas's Hospital with his mind greatly agitated, so that his friends were alarmed lest he should commit suicide. He complained of racking pains in all his limbs, which allowed him no rest, and which were considered to be rheumatic. The pains shortly subsided, but he did not recover his health, so that it was plain he was labouring under some structural disease, but of what nature could not be determined. On examining him after death, cancerous deposits were found in the liver, intestines, and heart.

The *spleen* has a similar exemption from pain in this disease; but the viscus enlarges, dropsy follows, and death is the consequence.

The *bladder* seems equally insensible. A patient laboured under ulceration and suppuration of the elbow-joint, and he shortly afterwards passed blood in his urine. Of this latter complaint he appeared to die; but, except an irritable state of the bladder, he suffered little or nothing in the vesical region. On examining him a soft cancerous tumor was found in the bladder.

Cancerous formations sometimes take place in the *lungs*, and yet it is impossible to distinguish the affection during life from phthisis, a disease in which there is no pain. A patient very recently died, in whom a cancerous tumor existed under the false rib; but, although troubled with incessant cough, his pulse was quiet, and he suffered no pain. Similar tumors have been found in the heart, not only without pain, but without any interruption of the circulation. The large cancerous masses which sometimes form in the duplicature of the mesentery or omentum are equally free from pain, and are frequently mistaken for ovarian dropsy, a disease whose greatest inconvenience is its bulk. The kidneys also have often attained a great size from cancerous deposit, and destroyed the patient without pain; the symptoms being, great emaciation, hæmaturia, attacks of suppression of urine, and perhaps dropsy. When the disease has formed externally, or among the muscles, there is likewise no pain. The patient assured me, says Mr. Hey, that he had walked without pain in his knee a week before his admission into the infirmary. These instances are sufficient to establish the general law of the disease being unaccompanied by pain, and that the inconvenience is generally local till ulceration or softening takes place. The duration of this disease, it has been stated, is very various, terminating in some cases in a few months, but in others lasting two or three years.

Diagnosis.—It is impossible to distinguish diseases depending on soft cancer from those caused by tubercle; but in parts where the tumor can be felt, its greater size, the greater *embonpoint* of the patient, and the general absence of hectic, afford in general a sufficient diagnosis between the two diseases. When the tumor cannot be felt, soft cancer can only be distinguished from the similar functional diseases it gives rise to by the intractable nature of the complaint, its slow but undeviating course, and, in a word, by a state of things which no ordinary derangement of the functions of an organ can account for.

But these are not the greatest difficulties in the diagnosis of soft cancer; for tumors occasionally form, as in Mr. Frogley's case, in the thigh, in the antrum, in the jaw, in the mammæ, and in other parts of the body, which similate tumors in the first or schirrous stage of soft cancer, both in form, size, seat, and intimate structure, but which have no tendency to soften or to take on a *malignant* character. Ambroise Paré, Morgagni, and the earlier writers have spoken of tumors of this character; but Bayle is the first author who can be said to have treated expressly on them, and he has described them as fibrous *degenerescences* of the mammæ. He says these tumors, at first fleshy, at length become cartilaginous or osseous, but do not become *cancerous*. Sir Astley Cooper has described them as *chronic mammary tumors*, attacking in general young women between 17 and 30, but which have nothing in common with cancer, as the patient preserves her best health. He describes them as of extremely slow progress, superficial, moveable, and lobular in structure. Sir B. Brodie also admits the existence of these tumors, which he describes as feeling "like *schirrous*, and which on cutting into, it feels like *schirrous*, so that I can give no other name to it," and which has no tendency on being removed to return. Cruveilhier describes them as fibrous bodies, as varying in size from a millet-seed or a cherry to the head of an adult, as having no tendency to cancerous softening, or to be reproduced when amputated, and are not otherwise inconvenient than from their size and weight. He has met with them in old women of 80 and upwards at

Salpêtrière, and in whom they had formed in early adult life. It is difficult to speculate on the comparative frequency of these benign tumors; but supposing cancer always to be reproduced after removal, the result of operations would give nearly an equal proportion of cancerous and fibrous tumors. But these data are probably unsure, and the subject is still open to much further and interesting investigation.

Prognosis.—This disease has in all instances proved fatal when an operation has not been practicable. The disease appears capable of being removed from the mouth with success; and the patient has survived amputation of the extremities, or its removal from a superficial position. The great majority of cases, however, have died, or else the disease has shortly returned and quickly proved fatal.

Treatment.—At present no remedy exists for this form of disease. Every general mode of treatment has signally failed, and its cure therefore depends on a specific medicine being discovered. The treatment in the actual state of medicine is, consequently, most unsatisfactory, and entirely palliative, or by opiates and attention to the general health.

If the patient lives moderately, diet appears to have little effect on the course of the disease.

Order V.—Of Melanoma or Melanosis.

Pathologists have given this term to a morbid production of a black or brown colour. The disease was first described by Laënnec.* In 1821 he published some new instances of it, and since that period it has been more particularly studied by Dr. Carswell and MM. Trousseau and Leblanc. This affection is not limited to man, but occurs in the horse, especially when glandered, and is more common in the dappled grey than in that of any other colour. It has also been found in the dog, the cat, the rabbit, the rat, the mouse, and other animals.

Remote Cause.—The only clue we have to the possible causes of this disease is mentioned in Chossat.† In six frogs, whose deaths had been induced by a long inanition, or from nine to twelve months, the red blood had completely disappeared, and was replaced by a black fluid similar to a dilute solution of sepia or of ink, which filled all the vessels of the limbs, mesentery, lungs, and brain. But the organ which was more remarkably the seat of this general melanosis was the liver, whose hepatic colour was changed to black, and stained paper like Indian ink, and the stain was not effaced at the end of six years.

In the human subject the remote causes of this disease are little understood, and it occurs in so few instances that it appears connected with peculiarity of constitution rather than peculiarity of cause. One might imagine it was some local atrophy of the parts, did it not generally occur in greatly hypertrophied and otherwise diseased livers.

Predisposing Causes.—Andral met with a decided melanotic induration in the superior lobe of the left lung in a girl 9 years old; and Lobstein met with an instance in an old woman between 80 and 90. The most common period is between the ages of 30 and 50, and it is a disease which equally affects both sexes.

Pathology.—Melanoma, like cancer and tubercle, may exist as a tumor or mass, or may be infiltrated into the various organs and tissues of the body; and, lastly, it may likewise be deposited at the free surface of the mucous and serous membranes.

When melanoma exists in masses, Laënnec has attributed to it two stages, or a stage of hardness and a state of ramollissement. In the hard stage the mass is of considerable firmness, so that it has been compared to suet, or to the substance of the lymphatic glands. The colour is generally of a soot-black, and it gives a stain to white paper or linen as deep as Indian ink; but in other instances it is of a yellowish-brown or bistre tint. In form the masses are sometimes spherical, sometimes irregular, and at others not like any geometrical figure. In size they vary from a millet-seed to a goose's egg; and Andral speaks of having met with tumors so enormous as to weigh thirty-six pounds. They are occasionally lobulated, and the lobules divided by cellular tissue. Laënnec considered that after an uncertain period the hard stage passed into the stage of remollissement, the tuber softening from its centre to its circumference, till at length the whole is converted into a black or brownish pulp or *bouillie*. He also thinks that the tumor having softened, ulceration may take place in the surrounding tissues, and the softened matter escape, as from an abscess, and the cavity perhaps ultimately cicatrize. Such is the course ascribed by Laënnec to melanoma. The fact, however, of the stage of ramollissement is disputed,—not that cysts containing fluid melanoma have not been met with, but because some pathologists conceive it may have been deposited in a fluid state.

Melanoma may be encysted or non-encysted; Laënnec has met with encysted tumors in the liver and the lungs; and Breschet has seen them in different parts of the cellular tissue. On the contrary, all the cases seen by Andral have been non-encysted, the tumor adhering more or less intimately to the surrounding tissues. Although neither nerves or blood-vessels have been traced into these tumors, Laënnec considered melanoma to be an organized growth or tissue; but Andral is of opinion that it is a veritable inorganic compound, and if sometimes the seat of vital phenomena, that those are owing to the living membrane which surrounds or is imprisoned in the mass. Chemistry does not greatly assist us in this difficulty. It has merely determined the melanic matter to be inodorous, insipid, opaque, miscible with water or alcohol, and as putrefying slowly. It is essentially, according to Thenard, compounded of carbon; according to Clarion, of albumen and of a peculiar colouring matter; according to Barruel, of the colouring matter of the blood united to fibrine; and lastly, M. Foy has given the following analysis:—

Albumen	15·00
Fibrine	6·25
The black principle, evidently carbonaceous or altered cruor . . .	31·40
Water	18·75
Oxyde of iron	1·75
Sub-phosphate of lime	8·75
Hydro-chlorate of potash. . . .	5·00
Hydro-chlorate of soda	3·75
Carbonate of soda	2·50
Carbonate of lime.	3·75
Carbonate of magnesia	1·75
Tartrate of soda	1·75

* *Bulletin de l'Ecole de Méd.*, 1805. No. 2.
† *Sur l'Inanition*, p. 74.

Besides being deposited in masses, melanoma is often infiltrated into the substance of organs, as of the liver, or of the lungs, or into the web of the mucous and serous tissues, especially after chronic inflammation, as in dysentery. It is also often secreted at the free surfaces of the mucous and serous tissues in a liquid state. Thus, in chronic peritonitis, and especially if a false membrane has been formed, the surface is often coated partially or generally with a black fluid. Andral gives a case in which he collected fluid melanic matter in considerable quantity from the free surface of the mucous membrane of the small intestines. It follows, therefore, that melanoma may be deposited in a solid state either in masses or in a state of infiltration; and likewise that it may be deposited in a liquid state at the free surface of membranes. There is nothing to show that melanoma is of a malignant nature; at least it appears to constitute an integral part of the bronchial glands for an indefinite period, but without giving rise to any symptoms. It often exists in many organs or tissues at the same time, and may co-exist with either tubercle or cancer. After having thus stated its more general laws, we shall proceed to give a few particular instances of it in the different organs and tissues.

Dr. Halliday found melanic tumors of the *dura mater*, and Lobstein has seen melanosis of the *optic nerve* on the left side, the melanic matter having penetrated two lines deep into the substance of the *brain*. The man died of apoplexy. Chomel has likewise given an interesting case of melanic matter situated in the cellular tissue at the base of the *orbit*.

Cruveilhier has met with melanic tumors in the *stomach;* and Andral has observed them many times in the sub-mucous cellular tissue of the *alimentary canal*, their mean size being that of a nut, and their most common seat being the colon. It has been stated that melanic matter is often found at the free surface of the mucous membrane of the stomach and intestines. Some pathologists also consider the black vomit and also melæna to be of this character. It has also been found incorporated in the mucous tissues of the alimentary canal, giving it a grey tint. Melanic matter has also been found under the *peritoneum* in masses; likewise in a fluid state at its surface, and also incorporated in its tissue.

A splendid specimen of melanosis of the *liver* is to be found in the museum of St. Thomas's Hospital. It has been observed in all these liver cases that the liver is enlarged. Chomel met with a melanotic liver in a dancing-master which weighed 14 lb. 7 ounces. It contained masses varying from the size of an oat to a pullet's egg. The gall-bladder and ducts were nevertheless filled with bile.

The *lungs* are, of all organs, those which are most frequently the seat of melanosis, and the melanic matter appears often to exist in them without affecting, in any degree, their functions or the general health of the patient, so that it can hardly be considered in these organs as a morbid product, and hence it has been termed, *melanose naturelle*. It has been found in masses and in a state of infiltration at the surface, and in the substance, of the lungs. It is also secreted by the free mucous surface of the *bronchial membrane*, marking the expectoration. The *bronchial glands* are also often loaded with it, and similar tumors have also been found under the *pleura costalis*.

Andral has seen a patch of deep black, as broad as a two-franc piece, and from seven to eight lines in thickness, under the serous membrane covering the *heart;* and a similar case is related in the *London Medical Repository* for 1823. Breschet, moreover, met with an instance of melanoma among the muscles of the heart. Melanoma has likewise been found in masses in the coats of the arteries; and in one instance Andral found them as large as a pea and as hard as a calculus, and therefore perhaps mixed with phosphate of lime.

Rayer has met with melanosis of the *kidney*, the melanic matter being deposited in the cortical substance, and the substance around them healthy. In some few instances, the urine is passed almost of a black colour, leading to the supposition that these organs may secrete fluid melanic matter.

The *lymphatic glands* of different parts of the body are frequently the seat of melanosis. The bronchial glands, it has been stated, are often filled with this black matter, and, under these circumstances, are greatly enlarged. Enormous masses of melanoma have been found in the pelvis and before the vertebral column, forming a sort of chaplet, and which Andral conceives to be lymphatic glands. It has likewise been found in the mammæ, and apparently affecting the glandular structure rather than the adipose or cellular tissue; and Dr. Rownel has reported a case of cancer of the breast from which flowed matter as black as ink. Breschet gives the case of an old woman that died at Salpêtrière of ulcerated melanosis of the groin; and many similar tumors, varying in size from a nut to a pullet's egg, could be traced along the groin. Melanic matter has also been found in the thyroid gland, in the ovaries, and in the uterus.

Many authors have spoken of melanoma of the *muscles* and *bones*. Dr. Halliday found it in the sternum and in the ribs, and also in the parietal and occipital bones, which were coloured black. In this case, the bones were more fragile than usual, but the periosteum presented no marks of disease. Lobstein met with it in the left femur, and found several melanotic tumors adherent to the *periosteum*.

Melanotic formations have been found in many different parts of the sub-cutaneous cellular tissue in the form of round masses of various sizes, and which have ultimately ulcerated. Alibert speaks of them as spherical in form, and of the size of a juniper berry, and when cut into resembling the parenchyma of a truffle; while Breschet and Jurine compare them to mulberries. A remarkable case of this kind was, a few years ago, in St. Bartholomew's Hospital, the melanic tumors covering nearly the whole back. These tumors, if removed, are said to be re-produced.

Symptoms.—The symptoms of melanoma have not been determined. In the lungs the deposit produces no sensible effect, except the tumors are large, and thus impede the functions of the different organs of the chest. In the liver, the organ is enlarged, and otherwise diseased, but neither pain nor other symptoms mark the disease. In the bones it occasions fragility; in the lymphatic glands and sub-cutaneous tissue, ulceration; but it does not appear, in any case, to be attended with pain except such as may result from the pressure of the tumors on the surrounding parts. When ulceration takes place the patient has died; but he would equally have died from the ulceration had no melanic matter been found; and this is all that can be fairly said to be known respecting the symptoms of melanosis.

Diagnosis.—The diagnostic symptoms between melanoma and many other tumors are not determined; when, however, it is superficial, the colour plainly distinguishes it.

Dr. J. C. Gregory examined a patient that died in the Infirmary at Edinburgh, who had been employed for the last 10 years of his life in the coal-mines at Dalkeith, inhaling coal-dust at every breath. In this case both lungs were of one uniform carbonaceous colour, which pervaded every part of their substance. The right lung was broken down in its upper and middle lobes into irregular cavities, and the walls of these cavities were black, and contained a considerable portion of a black fluid like ink. Portions of this lung were hepatized, and the rest of it, as well as the right lung, was infiltrated with a black serum. Dr. Christison analyzed the black serum (No. 109, *Edin. Med. and Surg. Journal*), and found its products similar to those arising from the distillation of coal. This case is curious, whether it be considered as an original or as a similated disease.

Prognosis.—Death is supposed to follow melanosis of the liver, and ulceration of the cutaneous or other tissue or organ.

Treatment.—No successful mode of treating this disorder is known.

Class III.—Of Morbid Poisons, and of the Diseases caused by them.—*Introduction.*

Morbid poisons are a class of substances secreted either by the patient's person, as that of typhus or of scarlet fever, or else generated by other sources, known or unknown, as that of cholera, or of intermittent fever. These poisons contaminate the healthy recipient, either in consequence of their miasmata being diffused through the atmosphere, or else by their being brought into still more direct contact with his person in his communication with the sick. The diseases they respectively engender are of a specific character, as measles, hooping-cough, or small-pox.

The diseases arising from these causes are numerous, and frequently of the most formidable description, and in the year 1839 they occasioned a mortality of 65,343, or nearly one-fifth of the whole number of deaths in England and Wales. The majority of them assume, on many occasions, an epidemic character; and history affords the most awful instances of their ravages. It is remarkable also, that many of these diseases, as the measles, hooping-cough, and small-pox, appear to have been of late formation, so that a date can be assigned to their first eruption. The cholera, also, which we have lately seen traversing Asia, Europe, America, and the northern shores of Africa, seems of this class, and is probably not of any considerable antiquity even in India, while in Europe and in America it appears to have been entirely unknown till its late appalling visitation, devastating the largest cities, and spreading over the fairest portions of the earth. Diseases consequently depending on this class of substances are most important, and merit on the part of the medical philosopher the gravest attention, both on account of their peculiar laws and complexity of phenomena, but also of their extreme intractableness and great fatality. The student can hardly be expected to understand this difficult subject, without some reference to the laws of poisons generally.

Poisons, of whatever nature, and especially medicinal substances, which are poisons when improperly applied, are subjected to certain general laws,—the most important of which are, first, that they have all certain definite and specific actions; secondly, that they all lie latent in the system a certain but varying period of time before those actions are set up; and lastly, that the phenomena resulting from their action vary in some degree, according to the dose, and to the predisposition of the patient. These laws are common to all poisons, but there are also many others which are peculiar to individual poisons or classes of poisons, and it may be necessary to notice a few of them.

The *first* law, or that of the definite and specific actions of poisons, cannot be doubted; for if it be supposed that agents acting on the human body do not produce their effects according to certain definite laws, we can neither determine the seat or course of any disease, nor direct nor judge of the operation of remedies. The definite action of causes is the basis of human knowledge, and must be equally true in medicine as in every other science. No physician, for instance, has seen castor oil produce tetanus, or colchicum intoxicate the brain, or opium inflame the spleen; he perfectly well knows that the first of these substances acts on the intestines, the second on the ligaments, and the third on the nervous system generally. The action of poisons, therefore, is not accidental, but determined by certain definite laws.

The action of poisons, though definite, is variously limited. Some poisons, for instance, act on one membrane, or on one organ, or on one system of organs; while other poisons extend their action over two or more membranes, or organs, or system of organs, or even over the whole animal frame. We have examples in aloes and jalap, of substances that act upon one membrane only, or on the mucous membrane of the alimentary canal. In digitalis we have an instance of a medicine that principally acts on one organ or the heart, greatly reducing or even stopping its action; while strychnine is an example of a medicine acting on one system of organs, or on the parts supplied by the spinal cord, producing powerful and sometimes fatal tetanic action of every voluntary muscle in the body.

It is seldom, however, that the action of poisons is limited to one membrane, or organ, or system of organs. The greater number of these noxious agents more usually act on two or more membranes, or organs, or systems of organs. Elaterium, for instance, acts on the mucous membrane of the intestinal canal and on the kidneys. Tobacco nauseates the stomach, intoxicates the brain, and affects the action of the heart. Antimony has an equally extensive range; it induces cutaneous perspiration, acts cathartically and emetically, and in large doses appears to cause gangrene of the lungs. Alcohol and opium are examples of substances acting still more generally, affecting not only the action or secretion of every organ or tissue of the body, but even in some instances altering their structure. Thus, alcohol has been shown to cause structural disease of the liver, of the stomach, and of the coats of the arteries, while opium tends to produce apoplexy and structural disorganization of the brain and its membranes. From the circumstance of these two substances acting not only generally but locally on a given number of tissues, they resemble in their effects those of many morbid poisons, as that of typhus fever, of scarlet fever, or of the small-pox.

The *second* important law of poisons is, that they lie

latent in the system a period of time which varies in different individuals, before they set up their specific actions. Rhubarb, for instance, produces no immediate result, but lies dormant in the system six or eight hours before its action is sensible on the bowels; opium, in the usual dose, is generally thirty minutes before it subdues the brain to its influence. The convulsions from strychnine do not follow till twenty minutes after its exhibition, and perhaps every substance, except hydrocyanic acid, has a greater or less sensible period of latency.

When a medicine, however, acts on more parts than one, a considerable space of time may elapse after it has affected one organ before it affects another: thus digitalis frequently occasions emesis before it acts on the heart, and the action of mercury on the bowels is frequently sensible for many weeks before the gums and salivary glands are affected. The doctrine of the latency of poisons is indeed so generally admitted, that their actual period has been a point on which the condemnation or acquittal of a prisoner tried for murder has turned in our courts of justice, when corrosive sublimate or hydrocyanic acid has been supposed to have been exhibited.

The *third* great law of poisons is, that being once roused into action, their effects are modified by the dose, the temperament, or the present state of the constitution of the recipient. The effect of dose in modifying the pathological phenomena of disease may be exemplified in the actions of oxalic acid and of arsenic. The specific action of oxalic acid is to inflame the mucous membrane of the stomach; but to ensure this effect the dose must be limited so that this poison may lie in the system many hours. On the contrary, if the dose be excessive and rapidly absorbed, the poison so disorders all the functions of the three great nervous centres that life is destroyed in a few minutes, and not a trace of disease is to found in any part of the body. Arsenic likewise is a poison which inflames and ulcerates the mucous membrane of the alimentary canal, but it requires some hours to set up its specific actions, for when the dose is large it in like manner destroys by general irritation, and not a trace of morbid change of structure is to be found after death. It follows, from this law, that the larger the dose or the greater the intensity of the poison, the more rapid its action and the less the probability of finding any trace of specific disease.

In studying the effects of dose on the constitution, we find some poisons are absorbed and are *cumulative*, while others are not absorbed into the system, or else are so rapidly removed that no cumulative effect is produced. Thus, in persons predisposed to the effects of digitalis, a dose so small as to produce no sensible effect whatever, will, if frequently repeated, at last destroy the heart's action. In cases, likewise, in which it is desirable to produce vomiting at the least expense to the constitution, the means employed are cumulative, or a repetition of small doses of ipecacuanha, or other emetic substance. This cumulative property of poisons, however, is by no means universal. There is no instance of jalap or of castor oil proving cumulative, and if a frequent repetition of them produces an increased effect, it is, perhaps, in consequence of the nervous papillæ with which they are brought in contact being more easily irritated by each application, and hence they induce a more violent result.

Temperament is also a circumstance which greatly influences the action of poisons. There are a few persons altogether insensible to the action of mercury, so that no quantity will affect their gums, or increase the secretion of the salivary glands. There are others, in like manner, the action of whose heart no quantity of digitalis will control. On the contrary, there are some constitutions so morbidly susceptible of these remedies, that it is scarcely possible to exhibit even a fractional dose without giving rise to their specific effects.

Besides natural temperament, *habit*, which may be termed an artificial temperament, has a powerful influence in reconciling us to particular classes of poisons, and of making them even sources of enjoyment. Thus tobacco, alcohol, opium, are all substances which in the first instance are to many persons productive of great discomfort, but by frequent repetition they cease to have any unpleasant effects, and their stimulus at length becomes a necessary indulgence. Still there are many poisons to which no repetition can habituate us, as arsenic, corrosive sublimate, or the preparations of copper. On the contrary, each repetition only the more debilitates the constitution, and renders it more susceptible of the action of the poison.

The present state of the constitution has also a powerful influence on the action of poisons; and it would seem proved, with some exceptions, that these agents act with an intensity proportioned to the debilitated state of the patient. There is indeed no duty more imperative on the physician than that of adjusting the dose to the strength of the patient, and nothing is more common than to forbear administering a medicine because the patient's strength will not admit of it. As a general principle, therefore, medicines may be said to act with a power proportionate to the debility of the patient.

Still there are states of disease which render the constitution of the patient, though greatly debilitated, insusceptible to the action of even powerful remedies. Thus, in typhus fever, the patient will often bear a considerable quantity of vinous stimuli without being affected by it. In tetanus, or hydrophobia, no quantity of opium will tranquillize the symptoms or procure sleep. Fallopius mentions a singular instance of the constitution being armed against the action of a poison. He states, that in his day a criminal was given up to himself and other anatomists to be put to death in any manner they might think proper. To this man, therefore, they exhibited two drachms of opium, but he labouring under a quartan ague, and the fit just coming on, the "opium was hindered of its effect." The man, therefore, having survived this dose, begged that he might take a similar quantity, earnestly entreating, if he escaped, he might be pardoned. The same dose was exhibited, but it was in the interval, and the man now died.

The experiments of Majendie may be referred to as affording many curious proofs of the state of the constitution in accelerating or retarding the actions of poisons. That physiologist has shown, if a poison be introduced into the system of such potency as usually to destroy life in two minutes, on bleeding the animal the same result will follow in half a minute, or in one-fourth of the time; and this experiment has often been repeated. Majendie has also brought to light the curious fact, if, after having poisoned the animal, and even after the poison has begun to act, we inject an aqueous fluid into its veins in such quantity as to cause an artificial plethora, that as long as this artificial plethora can

be maintained the action of the poison is superseded. No sooner, however, does the plethora cease, from the general effusion of water which follows into every cavity of the body, than the poison acts in the usual time, and even perhaps with more than its accustomed severity.

Mr. Hunter thought that no two poisons could *co-exist* in the same system together, or that, co-existing, they could not set up their specific actions at the same time. This hypothesis, however, is unquestionably erroneous; for we constantly see opium and digitalis, jalap and mercury, as well as many other combinations of medicines, producing their respective effects in the same system, and at the same time, by accelerating or retarding each other's actions. There is no truth better established in medicine, than that a combination of salts and senna produces a much more efficient and pleasant action than the exhibition of either remedy separately; and opium is an agent possessing a modifying or controlling power over every organ or tissue, without which it would be impossible, on many occasions, to reconcile the system to the introduction of many necessary and essential remedies. Poisons, therefore, are capable of co-existing together, and of so influencing the system that they reciprocally accelerate or retard each other's actions.

The general laws observable in the actions of medicinal substances are for the most part precisely similar to those which govern morbid poisons, or only differ in a few minor points; for these latter poisons have their specific actions and their periods of latency, while their phenomena equally vary according to the dose, or else the state of the constitution, or of the predisposition of the patient.

The specific actions of morbid poisons are distinctly proved by the fact, that we are enabled to determine, within certain limits, the course, symptoms, and pathological phenomena which result from the presence of any given morbid poison. No man, for instance, can confound the phenomena of small-pox with those of intermittent fever, or those of intermittent fever with syphilis, or those of syphilis with cholera; each of these poisons has its separate and peculiar laws, and consequently its actions are definite and specific.

The actions of morbid poisons also, like those of medicinal substances, are variously limited, some affecting only one membrane or organ, or system of organs, while others involve two or more membranes or organs, or systems of organs. Thus, tinea capitis is an example of a poison acting on one tissue of the body, and even then partially, namely, on the cutaneous tissue of the head. The waters of Switzerland contain a poison whose action is limited entirely to the thyroid gland. The contagion of hooping-cough and the virus of hydrophobia affect all the organs supplied by the eighth pair, or pneumogastric system. Instances of morbid poisons acting on two membranes or organs, or system of organs, are still more common, and form the great body of this class of disease. The poison of measles, for instance, acts no less on the mucous membrane of the eyes, nose, fauces, and perhaps on the mucous membranes generally, than on the skin. That of scarlatina acts not only on the mucous membrane of the fauces, and on the skin, but also on the serous membranes of the joints and of the abdomen. The paludal poison has a still more extensive range, hardly any organ or tissue of the body being exempt from its destructive ravages.

Morbid poisons also, like other poisons, have their period of latency; and, generally speaking, a much longer time elapses before their specific actions come into operation than takes place with medicinal substances. The virus of the natural small-pox lies dormant from sixteen to twenty days before it produces any constitutional disturbance; and a still further period elapses, of three or four days, before the specific eruption appears on the skin. The poison of scarlatina lies latent from seven to ten days after exposure to the contagion; that of the measles from ten to fourteen; while the poison of paludal fever has been known to lie dormant for a twelvemonth, and that of hydrophobia for a still longer time. These are examples of periods of latency far beyond anything that has been observed in the action of medicinal substances.

When morbid poisons act on more tissues or organs than one their actions are sometimes simultaneous, but more commonly they are consecutive, and frequently long intervals of time elapse between each successive attack. Thus, the poison of typhus fever may attack the lungs, the membranes of the brain, and the mucous membrane of the alimentary canal, and all these may be attacked contemporaneously; but it is more common that their attacks take place consecutively, or first on the alimentary canal, then on the brain, and lastly on the lungs, several days elapsing between each successive attack. In syphilis the poison acts on the part to which it is first applied—as the skin, throat, bones, and ligaments; and cases have been met with in which the throat, the skin, and the bones have been affected at the same time with the primary sore. It is more common, however, for them to occur *seriatim* and at very remote periods from the primary affection, so that many years frequently elapse before the poison has exhausted itself. In scarlatina also the peritoneum is not affected till many days after the eruption of the skin and the ulceration of the throat have altogether disappeared.

It occasionally happens that morbid poisons which usually act on a plurality of membranes, exhaust themselves on one or more without affecting the whole series. In the disease termed scarlatina simplex the poison sometimes exhausts itself entirely on the cutis without affecting either the mucous or serous membranes of the body. The rubeola sine catarrho is a similar example of the poison exhausting itself on the same tissue, the skin. In intermittent fever, when the dose of the poison is limited, and the disease properly treated, it is seldom that any organ or tissue is involved; yet, left to run its course, scarcely any organ or tissue would escape destruction.

Sometimes, when the morbid poison acts on many membranes, the usual order of attack is inverted. It is the general law of syphilis, that the bones are the last in the order of the secondary symptoms that suffer, but sometimes they are the first to be affected. In scarlet fever the affection of the skin may precede that of the throat, or the reverse may take place; and, in fever, the affection of the head may precede that of the intestines, though the latter is the most common.

It has been seen that the period of latency of medicinal substances being passed, and their actions set up, that their effects varied in a considerable degree, according to the dose, temperament, or present state of the constitution of the patient. With respect to the dose of a morbid poison, we rarely possess any direct measure of the strength of its miasmata. The paludal poi-

Elementary Principles of Medicine

son, however, of tropical climates, unquestionably greatly exceeds in intensity that of more temperate climates, and its effects are proportionally marked. Thus, in the West Indies, we have the yellow fever, with hardly a trace of organic disease after death; while, in Holland, we have a fever of less severity, but followed by enlarged livers or spleens, or else by dropsy; while, in this country, the fever is comparatively mild, and, if properly treated, for the most part terminates without any visceral affection. With respect to the influence of temperament in modifying disease, the small-pox offers very striking instances; for different persons inoculated or poisoned from the same source have suffered in every varying degree from this formidable malady, or from the horn, the distinct, the confluent, and the bloody small-pox; while, in the worst cases, the child has died in the primary fever, and before the specific action on the skin has been induced. It may, therefore, be laid down as a general law, that the more intense the dose of the morbid poison the more severe the form of disease; and also that fewer traces of organic alteration will be found after death than when the poison, or the disorder it produces, has been of a milder character. Thus, enlarged livers, disorganized spleens, and dropsy marked every case that died of the Walcheren fever, while in the West India and African fevers, though resulting from the same poison, scarcely a trace of disease is to be found.

The present state of the constitution also influences the event. Thus, persons of a good constitution, but ignorant of their danger, are often seen to pass through a mild form of typhus fever, while the nurses and others contaminated at the same source, but more alive to their critical state, have sunk without a struggle. As a general principle, therefore, it may be stated, that morbid poisons act with an intensity proportioned to the enfeebled or depressed state of the constitution; but this law is not universal. The hardy mountaineer is a surer victim, whether he visits the low countries of the tropics or the marshes of a more temperate climate, than the feebler native of those countries. The immunity the latter enjoys is probably owing to his habit of living in the noxious atmosphere; for let him remove to a more healthy climate, and then return to those regions of pestilence, and he will be found as susceptible of the poison as the hardiest stranger.

Another law of morbid poisons is, that two may *co-exist* in the same system; thus, scald-head and fever, measles and scarlatina, have often been seen at the same time in the same person. In this case the respective diseases sometimes appear simultaneously, and each runs its course unaffected by the presence of the other; but the more usual law of febrile poisons perhaps is, that when two co-exist, the one lies latent while the other runs its course, or they interrupt each other's progress, the active one becoming latent while the latent one becomes active, and occasionally they modify each other's actions. A case of intermittent fever was admitted into St. Thomas's Hospital which was not controlled in the usual time by medicine; suddenly, however, it subsided, and the small-pox appeared. The small-pox having run its course, and the patient being recovered from that disorder, the intermittent fever returned, and now readily yielded to quinine. A child, having been exposed to the infection of the small-pox, was vaccinated; in a few days, however, the small-pox appeared, and ran a very mild and modified course. When the small-pox had entirely subsided some action was seen in the punctured part of the vaccinated arm, and the cow-pox vesicle formed, but not till three or four weeks after the time it usually appears, and then exceedingly small.

The principal points in which the laws of morbid poisons agree with those of poisons generally having been stated, it will now be necessary to state those circumstances in which they principally differ. Many medicinal poisons have the property of accumulating in the system, and acting with an intensity proportioned, not to the last dose, but to the aggregate of the whole quantity that has been administered. Thus the last few minims of digitalis may stop the action of the heart, or the last few grains of mercury salivate the patient. There is, however, no well-authenticated fact which can be arranged under this law in the whole circle of morbid poisons. A given quantity of a morbid poison is perhaps necessary to produce a given disease, but below that point the miasmata perhaps circulate without injurious effect. The actual quantity, according to the experiments of Dr. Fordyce, is perhaps extremely small; for that physician, in hopes of mitigating the small-pox, inoculated with virus greatly diluted. The disease was not always produced, but, when produced, it assumed every form, character, and degree of severity, according to the temperament or constitution of the patient.

Another peculiar law of morbid poisons, and one wholly unknown to medicinal substances, is the faculty which the human body possesses of generating to an immense extent a poison of the same nature as that by which the disease was originally produced. A quantity of small-pox matter not so big as a pin's head will produce many thousand pustules, each containing fifty times as much pestilent matter as was originally inserted; and moreover, the blood and all the secretions of the body are supposed to be also equally infected with the matter of the pustules. The miasmata secreted by one child labouring under hooping-cough are sufficient to infect a whole city.

Perhaps there is a still more remarkable law of morbid poisons, and unknown to those of a different class, which is, that many of them possess the extraordinary property of exhausting the constitution of all susceptibility to a second action of the same poison. This is the case with scarlatina, measles, the small-pox, the hooping-cough, and indeed with a considerable class of disease. Still it would seem that a temporary protective influence was imparted by most morbid poisons, for it is certain that few persons suffer a second attack of the same epidemic disease; and, consequently, it follows that the previous action of the poison must for a time impair the susceptibility of the constitution to its attacks. This beneficent law is of great importance in social life; it enables those that have recovered to attend on those that are sick, and allows a mother fearlessly to nurse her child in a dangerous and contagious distemper she has herself passed through.

It only remains to mention one other law, which is but little shared by poisons of the vegetable or mineral kingdoms. It is well known that the actions of vegetable or mineral poisons are not influenced by the climate in which they are administered. Climate, however, has the property of greatly modifying the intensity of morbid poisons. The severe forms of typhus so common in the north latitudes are hardly known in more southern latitudes, and the cholera has been infinitely more fatal

Elementary Principles of Medicine.

in Europe and in America than in the country which gave it origin; but besides influencing the intensity of the disease, climate or season, or both, greatly modifying the specific nature of morbid poisons. In one season, for instance, typhus fever will attack only the glandular structure of the intestinal canal; in another only the mucous tissue of the same part, the glands or follicles being healthy; while, in another season, no disease whatever of the intestinal canal can be traced. Again, in one paludal district the liver will be inflamed and the spleen healthy, and in another the liver will be unaffected but the spleen disorganized. In both cases the genuine character of the disease remains the same, but its specific character varies. It will have been seen that this variety of pathological phenomena is also caused by peculiarity of idiosyncrasy, and that nothing can be more different than the distinct, the confluent, and the horn small-pox from each other; and yet all these different varieties may exist in different persons inoculated with the same poison. The character of the vaccine pustule is equally various; so that that which ensures exemption from the small-pox has not yet been determined; neither have pathologists determined the primary forms of syphilitic ulcers. It is important, therefore, to remember, in the study of morbid poisons, that absolute uniformity of pathological phenomena is not to be expected in different persons and in different seasons. There is a limit, however, within which their variations oscillate, and within which nature has bounded her deviations.

The laws of poisons are more important than their *modus operandi;* but this part of the subject has been deeply investigated by modern physiologists, and deserves some consideration. The great and striking alterations which often take place in the blood, led from a very remote period to the doctrine of humoralism, or that a morbid state of the fluids was the great and primary cause of disease. On the contrary, when anatomy began to be cultivated, and nerves traced into every organ and tissue, it was supposed that disordered actions of these prime agents of motion, and of the great phenomena of animal life, were the great causes of disease, the morbid state of the fluids being secondary. Fontana determined to prove this latter theory, and found, to his surprise, on laying bare the sciatic nerve in a great number of rabbits, that neither the venom of the viper nor the poison of the ticunas, nor hydrocyanic acid, when applied to it, produced the phenomena of poisoning, and that no other consequence resulted beyond what would have been produced by a similar mechanical injury.

Fontana having shown that the phenomena of poisoning do not result from the application of the deleterious agent to the trunk of the nerve or to the *solids*, determined to ascertain whether they followed after absorption, and consequently contamination of the *fluids.* He therefore injected the venom of the viper, hydrocyanic acid, or other poisonous substances directly into the veins of different animals; and he found that, although the nerves of a part may be steeped in these poisons with impunity, yet no sooner did the substance enter the veins, than the animal, after uttering a few horrible shrieks, struggled and almost instantly died, and thus demonstrated a morbid state of the fluids as well as the existence of a tissue of extreme sensibility, and with which the poison being brought into contact, accounted for the death of the animal. Fontana pursued this subject one step further, and showed if poisons acted by absorption, that this absorption was in many instances extremely rapid. He submitted a number of pigeons to be bitten in the leg by the viper, and chopped the wounded limb off at different intervals after the introduction of the venom, and found, as the result of an extensive series of experiments on several dozens of pigeons, that none recovered when the poisoned leg was removed at a later period than 25 seconds, though the phenomena of poisoning did not occur till several minutes later.

The experiments of Fontana had shown, supposing a poison to be introduced into the veins, that all the phenomena of poisoning were accounted for; but still it might be said that the fact of absorption was something wanting of strict demonstration; and for the further prosecution of this subject we are indebted to Segalas, who showed, if the arteries and veins of the mensentery of a dog be tied, that a quick acting poison would lie in harmless contact with the corresponding portion of the intestine for many hours; but no sooner were these ligatures removed than poisoning took place in a few minutes. Majendie even has carried this proof of the veins absorbing still further, for he amputated the leg of a dog, having first introduced a portion of quill into the femoral artery and vein, in such a manner that, on dividing these vessels, the leg hung connected with the trunk solely by means of the quill, all continuity by means of the solids being cut off. The poison was now introduced into the paw, and in four minutes the animal was under its influence.

By these experiments, it is apprehended that Fontana, Segalas, and Majendie have completely demonstrated the absorption of poisons by the veins, and consequently of their circulating with the blood; and that no doubt may remain on the subject, modern chemistry has demonstrated the actual presence of many medicinal substances either in the blood itself, or else in the secretions from it. Thus after a treatment by soda, large quantities of uncombined alkali have been found in the serum. Alcohol has been obtained by distillation from the blood; while iodine, rhubarb, the nitrate of potash, and a large number of other substances taken into the stomach, have been found in the urine. It follows, then, that poisons are absorbed and mingled with the blood, and are conveyed directly to the parts on which they act, passing with impunity over others for which they have no affinity.

The fact of morbid poisons in like manner being absorbed, and mingling with the blood, has been shown by many continental writers; but perhaps the experiment made by Professor Coleman is the most satisfactory. "I have produced the disease (the glanders) by first removing the healthy blood from an ass, until the animal was nearly exhausted, and then transfusing from a glandered horse blood from the carotid artery into the jugular vein. The glanders in the ass was rapid in its progress, violent in degree, and from this animal I afterwards produced both glanders and farcy." Both scarlatina and measles have also been produced by inoculation from the blood of patients labouring under those diseases.

The circumstance of the presence of a poison in the blood is supposed by Andral to produce, besides its toxicological states, certain alterations in its physical condition. Thus he conceives a specific cause has a tendency to destroy or reduce the quantity of fibrine in the

blood, which he has found in some instances to be only one part in a thousand. Hence he adds, whatever may be the nature of the pyrexia, the blood, whether it be taken from a vein or collected from the heart and arteries after death, always exhibits the following characters—namely, that the serum and clot are incompletely separated the one from the other, so that the clot is consequently large, and often appears to fill almost entirely the bleeding-basin. Its edges also are never raised, and its consistence is inconsiderable, so that it is easily torn, broken down, and reduced to a state of diffluence, and in this state it becomes grumous, and discolours the serum. It is also remarkable for the absence of all buff, which is rarely met with in typhus, in measles, in scarlatina, or in small-pox, unless there has been some inflammatory complication; and even when it does exist, as in confluent small-pox, with large collections of pus, the buff is soft and gelatinous, and, by expression of the serum, is easily reduced to a thin pellicle. This defect of fibrine he conceives to be the cause of the great tendency to hæmorrhage, and to that stasis or congestion so remarkable in typhus, scarlatina, and other diseases dependent on morbid poisons.

The facts and arguments which have been adduced, have, it is apprehended, distinctly proved that morbid poisons act in all instances not capriciously, but according to certain definite and specific laws, modified by the influence of climate, temperament, or the magnitude of the dose; also, that they mingle with the blood, with which they continue in latent combination a certain but varying period of time; and likewise that many of them are capable of co-existing together in the same system. Two other remarkable laws result from the study of morbid poisons,—or that these singular agents are not acted upon by medicinal substances as long as they continue latent: and again, that when they act on more tissues than one, the remedy which is an antidote to its action on one is often absolutely powerless when it affects another tissue; so that many different remedies are frequently necessary to combat the varying phenomena of the same disease. A knowledge of these laws is necessary for understanding this class of disease, and it is hoped that by their application many of the difficulties which have hitherto obscured the doctrines of fever, of syphilis, of hydrophobia, and of many other diseases incident to the class of morbid poisons, may be removed, and that this portion of medical science may be placed on a surer foundation, if not on a permanent basis.

Of the Typhoid Poison.

Typhus fever is the only continued fever of this country; it runs an indefinite course, has no intermissions, is of great fatality, and is both infectious and contagious. The number of persons reported to have died of this disease in England and Wales, in the year 1839, was 15,666.

It is uncertain whether the ancients were acquainted with this fever,—at least none of their descriptions correspond to it. The first authentic accounts of it are to be found in the early British chronicles, and they describe it as spreading in our courts of justice, and giving rise to what have been termed "the black assizes." The last black assizes happened at the sessions of the Old Bailey in 1756, when the lord mayor, two of the judges, and several eminent and other persons died infected, as was supposed, by the prisoners. This fever has had many popular appellations—as the jail fever, hospital fever, ship fever, putrid fever, brain fever, bilious fever. We are indebted, however, to Pringle and to Fordyce for having shown that these supposed different fevers are identically the same, and have no such essential differences as constitute them distinct genera. The phenomena of typhus indeed vary in some degree in different years, and in different persons in the same year, but not to a greater degree than those of small-pox or of scarlet fever. While the British physicians were employed in generalizing this fever, and in determining many of its laws, the French physicians, and especially Serres, and Petit, and Louis have the great merit of having perfected its pathology.

Remote Cause.—Typhus fever prevails not only in Great Britain but likewise over a great part of the north of Europe, and also of North America. Indeed its range may be said to be limited to the space between the 60° and 40° of north latitude, for it is little known to the south of the Mediterranean and towards the equator. The poison appears, therefore, to have a local origin, but the mode of its generation has hitherto eluded the penetrating search of all those who have hitherto attempted the investigation of this difficult branch of medicine.

The decomposition of vegetable matters is found to give rise to paludal, or to the class of intermittent fevers, and consequently the causes of typhus fever have been sought for in the decomposition of animal matter. A large body of facts, however, prove that this hypothesis cannot be true; for Dr. Bancroft has shown that the classes of persons most employed about animal matters, as butchers, curriers, sugar-bakers, knackers, and others, are remarkably exempt from fevers. It has been next thought that the decomposition of the human body generated this virulent poison; but many thousand bodies have been dug up, with a view of levelling church-yards, both in this country and in France; they have been re-coffined and re-interred, and this at all seasons of the year, but without the persons employed being in any degree affected with fever. The experience also afforded in our anatomical theatres shows that dead animal matter does not cause fever; Dessault used to affirm, from the general exemption of his pupils, that the old proverb "morte la bête mort le venin" was proved; and Lallemand and Dubois adopted the same maxim. Ribes, whose class amounted from 120 to 160 pupils annually; and Serres, after witnessing the effects of dissection on an aggregate number of 9600 pupils, both assert they never remarked any disease existing among their pupils which could be attributed to the emanations incident to the dissecting room. Dupuytren, Dumeril, Jadelot, Breschet, Andral, and Parent du Châtelet, all bear similar testimony, and some even assert the greater exemption of the pupils of the dissecting-room to be remarkable compared with those frequenting the wards of the hospitals. The hypothesis, therefore, of the poison of typhus fever emanating from the putrefaction of dead animal matter does not at present appear to be satisfactorily supported, although the depressing effects of miasmata thus generated probably greatly predispose to the disease.

The impossibility of assigning any definite origin to the typhoid poison has led to the inference that it may have a telluric source, and be evolved according to laws not yet understood. The grounds for this opinion are, that although typhus fever is endemic and sporadic at

every season of the year, yet that it is occasionally greatly epidemic, and at irregular periods, varying it is supposed from four to sixteen years. When epidemic, it continues to prevail to a great extent for two or three years, and has its commencement, its point of culmination, and its period of decline in each year. Another argument for this hypothesis is, that it appears little influenced by season, prevailing to nearly an equal extent in winter, spring, summer, and autumn, so that the poison must be extricated under conditions little influenced by temperature. At all times, also, it follows the law of most poisons supposed to emanate from the earth, or that it most affects low countries, the banks of rivers and canals, although in epidemic seasons it prevails equally on the mountain as on the plain. Its greater prevalence, particularly in crowded districts of cities, in addition to their being generally low and ill drained, may be accounted for by the fact of the contagious nature of the disease. Supposing this poison then to have a telluric origin, it is probable, from the disease being unknown in tropical climates, that it must be volatilized, destroyed, or decomposed, at a not very high temperature. From its pathological phenomena, moreover, varying in different seasons, and in different epidemics, it is evident the poison undergoes certain modifications from some unknown combination of causes.

Predisposing Causes.—There are few diseases where the predisposing causes so greatly influence the reception of the poison as typhus; for although this surprising and appalling malady occasionally attacks the wealthy, yet it is admitted to be the disease of the *poor*, and not of the *rich*. Dr. Baillie stated, that in his extensive private practice he had scarcely met with an instance of typhus fever, and this in seasons when the *poor* were falling in large numbers. The physical condition, the many privations, and the mental sorrows of poverty are among the most powerful predisposing causes of typhus; and when, in addition to these, bad draining, defective ventilation, bad supplies of water, increased filth, and overcrowding are present, the mortality is often frightful. This statement cannot be better illustrated than by adding, that the average number of deaths in the gentry living at Bath, is 1 in 55, while in the *cellar* population of Liverpool the average age of death for the whole town is 17 to 18 years only. In every large city the great spread of fever is limited to its worst localities, as Whitechapel, the low districts along the banks of the Thames, the courts about Holborn, and the crowded population of St. Giles's. Famine enhances all these accidents; and though not the cause of fever, yet greatly prepares the system to receive the fatal germ of this pestilence. In Ireland, from the year 1721 to 1728, there was scarcely a case of fever; but after the latter year three bad harvests occurred in succession, and provisions rose to an extravagant price, and now fever broke out and continued to be epidemic till 1732. The year 1739 was also one of great scarcity, and fever again broke out and continued to prevail with such virulence, that in 1741, 80,000 persons are estimated to have died in Ireland from this cause alone. In the year 1800 there was a similar scarcity, and a similar prevalence of fever; and again in the year 1816, not only a year of famine, but of great commercial distress, fever again raged to a most distressing extent not only in this country but even in a great part of Europe. In the present year, 1843, fever is said to prevail in Glasgow to such a degree that the number of burials exceeds that of the most fatal years of cholera, the condition of the pauper being a penny a day allowed by the parish.

Armies on actual service are exposed for a time to almost all the severest privations of civil life, together with the addition of great fatigue; and the history of every campaign in Europe has shown that no sooner has the army entered into winter quarters, than with hardly an exception fever of a most destructive nature has broken out among the troops, spreading along their communications, and devastating long lines of country.

The extent indeed to which fevers prevail in armies cannot be better shown than by stating the report made to Napoleon after the termination of the campaign of 1807, by the peace of Tilsit, of the numbers of the troops admitted into hospital, by which it appears there were—

Of Fevers	210,000
Killed and wounded . . .	100,000
Venereal	62,000
Miscellaneous	48,000*

Again, in the campaign of Moscow, fever even more than the sword hung upon the traces of the retreating army, and thinned the ranks as fatally as the snows of Russia. Of this fever Kutusoff died, at his head-quarters at Bunzlau, after having delivered Russia in the extremity of its peril, and achieved the overthrow of the mightiest armament of which history has preserved a record. This fever spread its ravages for the next four years through every kingdom in Europe.

The influence of other predisposing causes is much less marked: sex does not appear to affect the liability, except perhaps from women being more exposed as attendants on the sick. Thus, in Glasgow in 1836, of 2260 cases 49·5 per cent. were males, and 50·15 per cent. females. In Edinburgh in 1819, of nearly 16,000 patients, 57 per cent. were females, and 43 per cent. males.

All ages are liable to typhus, but the extremes of life have a trifling exemption. Thus, Dr. Cowan found in the epidemic in 1836, that at Glasgow the proportion of deaths according to age was as follows:—

Ages .	5 to 10	10 to 15	15 to 20	30 to 40	40 to 50	50 to 60	60
Population . .	25,707	21,211	20,745	26,419	18,014	11,640	10,220
Fevers . . .	191	318	501	309	128	43	11
	1 in 134	1 in 66	1 in 41	1 in 85	1 in 140	1 in 270	1 in 920

* Alison's History, vol. vi., p. 308.

Season has some but not great influence over this affection; for out of 51·944 cases of fever admitted into the different hospitals of Great Britain and Ireland, the total number in January was 2895, February 2825, March 3152, April 3374, May 3990, June 4365, July 4999, August 5621, September 5046, October 5624, November 5054, and in December 5359. The disease therefore appears to be more frequent in summer and autumn than in winter and in the spring, in the ratio of 3 to 5. The effects of a town life, compared with a country life, in predisposing to typhus, is not determined. In the years 1838 and 1839, the numbers per cent. of the population that died of typhus in the metropolis were ·219 and ·296; while in England and Wales the proportion for the same years was ·125, and ·101.

The poison, however fostered or generated, yet having once produced the disease, establishes a new source of infection in the patient's person, which now secretes a poison which is both contagious and infectious.

Infectious.—The proof of the infectious nature of the typhoid poison is, that in hospitals we often see patients labouring under other diseases, as soon as a case of fever comes into the ward, shortly afterwards fall ill of that fever, although they have not left their beds, or in any way approached the infected person; and this occurs when other persons in the same building, and in every respect similarly circumstanced, except living in the same ward with the fever patient, escape.

The distance to which the miasmata may extend around the patient's person so as to communicate the disease is not accurately determined. Experience, however, has shown that in a large well-ventilated ward a space of three feet around the patient's person so dilutes the poison that the disease rarely spreads. When, however, three, four, or more fever cases are collected in the same ward, nobody in that ward is safe, and patients the most remote from the diseased person will take the disease. It is under these circumstances that the students, nurses, and hospital attendants of every kind constantly fall from fever in large numbers.

Contagious.—The argument for the contagious nature of this disease is, that it has been observed that the gentlemen employed to bleed, and the nurses employed to exhibit enemata to the fever patients, have been the parties who have at all times been seized in the largest proportion with typhus, the danger increasing according to the degree of personal contact: the most striking proof, however, of its contagious nature is its spread by

Fomites.—The communication of the disease by fomites has been proved by the laundresses at the fever-houses, and who have no immediate intercourse with the patients, falling ill in unusual numbers. The persons also employed to take care of the clothes of the soldiers sent to the Hospital Salpêtrière, labouring under fever, in the disastrous campaign of 1814, fell ill of that disease. Another satisfactory proof of the contagious nature of fomites, is the endless succession of persons seized with fever in the lodging-houses for the poor throughout the country, caused by the miasmata, as is supposed, adhering to the walls and furniture of the room.

Mode of Absorption.—The typhoid poison, being diffusible through the atmosphere, must be introduced into the system by means of the mucous membranes, and being also contagious it seems probable it must be absorbed by the skin.

Period of Latency.—The typhoid poison, being absorbed into the system, infects the blood. This was proved by Mr. John Hunter, who injected into the veins of a bitch half-gone with pup a quantity of serum taken from a person ill of fever, and who soon after died. The animal turned instantaneously sick, vomited, and soon miscarried, but in two or three days recovered. Gendrin injected an ounce of blood drawn from a person labouring under fever, into the cellular membrane of the groin of a cat. The animal vomited, and died in seven hours. As these accidents would not have happened with healthy blood, it may be inferred that the poison infects the blood, and circulates with that fluid in a latent state, for a period which varies greatly in different individuals. Some persons have sickened immediately on entering the chamber of a person ill of fever, and others have vomited on examining the fæcal matter he has passed; but in general the period is much longer, and its extremes may be stated at from two days to two months—the more usual period being from two to three weeks.

Co-exists.—It is not unusual to witness the combination of typhus and syphilis; of typhus and erysipelas; of typhus and the itch, in the same person. Typhus, therefore, may co-exist with many other affections depending on morbid poisons.

Pathology.—The theory of this disease is, that the typhoid poison having been absorbed and mingled with the blood, lies latent a certain period, after which it primarily induces certain derangements of function of the great nervous centres, as the brain, the cord, and great sympathetic, and consequently of the organs they supply. These derangements constitute the phenomena of fever, and are—alterations of temperature—changes in the force and frequency of the pulse—disorder of the alimentary canal—headache, and other concomitant affections. In severe cases the fever thus established has destroyed the patient in a few days, without leaving a trace of inflammation or other organic disease in any part of the body. More generally, however, after the fever has lasted a given time, as a few hours, or a very few days, certain secondary actions or "*specific inflammations*" are set up in a limited number of the organs or tissues of the body,—as inflammation of some portion of the mucous membrane of the alimentary canal; 2ndly, inflammation of the brain, or its membranes; 3rdly, certain cutaneous eruptions; and lastly, inflammation of the bronchial membrane, or else of the substance of the lungs. The poison, however, does not necessarily run through all this series, but often exhausts itself on one or more of the above-mentioned tissues. Thus, in one year the lungs will be attacked in every case; in others, the membranes of the brain; and in others, the alimentary canal; while in other years such attacks will be rare, and the exception and not the rule of the disease. The order, also, in which the organic lesions are set up varies much in different years. Sometimes the membrane of the brain will be first affected—at others, the tissues of the alimentary canal; and at others, the substance or other part of the lungs. Such irregularities are common to all morbid poisons, and many years must elapse before the relative frequency and order of their occurrences can be determined, and this intricate problem of pathology unravelled.

The popular nature of this treatise and our very limited space will not allow us to enter very minutely into the pathology of fever; but when the typhoid poison

produces inflammation of the mucous membrane of the alimentary canal, its seat may be either the web of the membrane, or its connecting cellular tissue, although commonly both are affected, or else its follicular structure.

The law which determines this election of the poison is not understood; but it is ascertained that in many years the follicles are the parts principally affected, while in others they are with few exceptions healthy. Thus, from 1813 to 1832, scarcely a case of fever was examined in which the follicles of the alimentary canal were not found ulcerated or otherwise greatly diseased. In 1832, however, when the cholera appeared, the follicular structure almost ceased to be affected, and the web of the mucous membrane was more generally inflamed; again, in the years 1837–8, though the follicles and web of the membrane were occasionally seen affected, yet for the most part not a vestige of the inflammation of any part of the mucous membrane of the alimentary canal was observed. When the inflammation attacks the web of the membrane, that inflammation may be either the diffuse, the serous, or the ulcerative; and in all these instances the colour of the inflamed part is of a deep venous red, almost approaching to blackness. When the follicular structure is inflamed it is liable to the serous, the adhesive, or the ulcerative inflammation. In the one case the gland is enlarged and transparent, in the other hard and granular, whilst in the last the ulcer may take a variety of forms. Indeed, the tendency of every inflammation of the alimentary canal is to ulcerate, and the number of ulcers is various, or sometimes only one; sometimes several, even to affecting every patch of Peyer's glands, while in the stomach they are sometimes so numerous that that organ appears to be riddled. It occasionally happens that some one of these ulcers burrows so deeply that it ruptures the peritoneum, and the patient dies of peritonitis. The parts of the alimentary canal usually attacked are the cæcum or ileo-cæcal valve, the inflammation extending upwards and downwards, often for several inches. In a few instances the colon or small intestines are the exclusive seat of the disease, and in still rarer instances the stomach; but it frequently happens that the inflammation is seated in two or more of these parts. Again, when the adherent surface of the mucous membrane of the alimentary canal is the seat of the disease, the inflammation is either the diffuse or suppurative. When the former, the connecting cellular tissue is rendered more easily lacerable than in health, and consequently considerable portions of the mucous membrane can readily be detached by the handle of the scalpel. In the latter case, a number of small abscesses form like so many pock, which at length rupture into the intestinal canal. In general, when the intestines are inflamed or ulcerated, the mesenteric glands corresponding to the diseased part are enlarged and evidently inflamed, but whether from sympathy or from a specific action of the poison is not determined.

The parts next to the intestinal canal, which are the most important as well as the most frequent seat of the action of the typhoid poison, are the brain and its membranes. Diseased function of the brain, as delirium, exists in five cases out of six in typhus; but delirium of the most marked character is often unattended with any trace of inflammation, either in the membrane or of the brain itself. Dr. Tweedie states, that he examined fifty-four cases that died with well-marked symptoms of cerebral affection, yet in fourteen cases no trace of disease in the brain or its membranes could be found. When the brain is affected it is generally found to be abounding with more points of blood than usual; a state of parts supposed to be diffuse inflammation of that organ. Some small portions at its surface, also, are sometimes softened, or achromatously inflamed; but in other respects the brain is healthy. The membranes of the brain are much more frequently diseased than its substance, and are the more specific seat of the poison in fever; they are liable to all the degrees of inflammation to which they are at any time subjected, as the diffuse, the serous, the adhesive, and the purulent. The serous inflammation, however, is the most common, and the quantity of fluid effused varies from a drachm to an ounce or more, and this is generally mixed with points of lymph or pus.

The organs next in order of attack are the lungs; and the frequency with which they are attacked varies greatly in different seasons. Some seasons will pass with scarcely a single case of this tertiary action of the typhoid poison, while in other seasons every case of fever will show more or less affection of the lungs. The bronchial membrane and the substance of the lungs are the parts affected; but the former is most frequently attacked, and is the seat of the serous or of the purulent inflammation. When the substance of the lungs is inflamed, that structure is liable to the diffuse and serous inflammations, and also to the red and grey hepatization; but of these the serous inflammation is the most common, and it is not unfrequent to see flow from the lungs, as they are removed from the body after being cut into, a sero-sanguineous fluid, as abundantly as from a large sponge.

The cutaneous tissue is more constantly affected in typhus than the lungs, but its affections are of less moment. These affections also greatly vary in frequency in different seasons; for in some years they equal 70 per cent., while in other years their occurrence is only occasional and accidental. These affections are petechiæ and sudamina. The former consist of a number of small round spots, like flea-bites, of a dull roan colour, slightly salient, and from half a line to two lines in diameter. Their more common seat is the chest, the abdomen, and more rarely the thighs, arms, face, and back. This eruption does not appear on all parts it attacks simultaneously; neither does it appear to follow any given order of succession. It consists of many different crops, whose duration is not always the same; for in some cases they will disappear after two or three days, while in others they will last twelve or fifteen days. Chomel is of opinion that the same part may be affected by a succession of crops, each dying away at the end of three or four days.

The sudamina are small hemispherical vesicles, or transparent bladders, from a quarter of a line to a line in diameter, formed in the cutis, and so transparent that when we look at these little bladders obliquely their appearance is most brilliant. Regarded, however, in a direction perpendicular to their axis, they are so diminutive as frequently to escape observation. Still they are always sensible to the touch, and if presssed they rupture, and the finger is moistened by the fluid they contain. This fluid, perfectly transparent when the vesicle is first formed, Chomel affirms, becomes opaque after a few days, and no longer fills the vesicle, which shrivels, and at length desquamates. This eruption is often seen in the first instance on the sides of the neck—in the axillæ—in the

groin, and in many cases it is limited to these spots. In other cases, however, it covers the whole trunk, and in others the whole body. This eruption appears later in the disease than the petechiæ, and most frequently about the middle or end of the second stage of the fever.

Ulceration of the nates and back sometimes takes place towards the end of this fever, bnt appears to result rather from the debility of the patient and his supine posture than from any specific action of the poison.

Symptoms.—The varying intensity of typhus fever has induced pathologists to divide this disease into typhus mitior and typhus gravior. This division is founded in nature; but it seems proper also to add a subdivision founded on the different affections of the cutaneous tissue, and the arrangement of its varieties will then be as follows:—

Typhus mitior - - - -	Typhus gravior.
Typhus mitior petechialis -	Typhus gravior petechialis.
Typhus mitior sudaminalis	Typhus gravior sudaminalis.

The structural lesions of other organs or tissues than the skin afford no data for a further generalization, because the lesions are so frequently similated by mere functional derangements, or else masked by local insensibility, that perpetual error would arise from the adoption of new species founded on them.

According to Chomel, out of one hundred and twelve cases of typhus fever, in seventy-three cases the invasion was sudden, while in thirty-nine it was preceded by headache, pains in the back, nausea or vomiting, constipation or diarrhœa, together with slight rigors followed by heat, and terminating either with or without sweats. When these symptoms exist, they usually last two or three days, some increasing and others disappearing, till at length those which are more particularly characteristic of typhus are established.

Typhus fever is compounded of primary fever, and of such symptoms as the organic lesions may give rise to. The phenomena of fever are supposed more particularly to consist in shivering, heat, sweating, and in an increased frequency of the pulse; but though these may be all present, yet each and all of them may be wanting. Rigors, for instance, are often absent; the temperature of the body may be lower than natural; the sweat is at all times accidental, and the pulse in a few cases is preternaturally slow. The phenomena of typhus fever, therefore, must be sought for in other than the group of symptoms that have been mentioned.

The most remarkable symptom of the typhoid poison is the extreme degree of prostration, both of the physical and intellectual powers of life, which it produces. This is so great that there are few patients who are not compelled to take to their beds on the first or second day of the attack; for they cannot take a step without staggering or falling, nor sit up unless supported; and even when in bed are hardly able to change their position, or assist themselves in any manner. The functions of the brain are equally depressed, and somnolence in a greater or less degree is almost universal; so that the patient is aroused with difficulty, and relapses on ceasing to be questioned. In this state their memory, though ordinarily correct, is slow; their minds, though not perverted, are incapable of all intellectual exertion, and they lie indifferent to all around them, and even to their own situation. The effects of the poison, of course, vary greatly in degree; but although delirium is often active in the first instance, yet the group of symptoms which has been described is by far the most common.

This depressed state of the powers of life has often proved fatal to the patient in the first few days; but these are exceptions, and more commonly the disease runs its course, and is divided into three stages, each stage being known by the state of the tongue, which is in the first stage white, in the second brown or black, and in the third, in the event of the patient's recovery, it again becomes white, and at length natural. These states of the tongue do not indicate any given organic or functional lesion, either of the brain or alimentary canal; for it is equally white, or covered with sordes, whether those parts be or be not inflamed. They consequently merely mark the degree in which the system labours under the action of the poison. These different stages, however, are generally accompanied by certain states of the vascular system. In the first stage, then, or as long as the tongue is white, the pulse is generally full and strong, and seldom exceeds 90 to 110; in the second or brown-tongue stage, the pulse is small, and is frequently increased to 120 or 130; and in the third stage, it either gradually returns to its natural standard, or else becomes almost countless—a mere vibration, and in this state the patient's case is generally hopeless. The duration of these stages is very various, and even some one or more of them may be wanting; but in a twenty-one days' fever each stage may last a week, but more frequently they are of unequal length, and the disease much longer.

The symptoms of typhus, it has been stated, are compounded of those of the general depression and of those which result from the accompanying functional lesions of the alimentary canal, the brain, the lungs, or of the skin.

With respect to the alimentary canal, *Diarrhœa* is the law in fever, and prevails in a great majority of cases. Most patients, for example, are purged from the very first day of the attack, in a greater or less degree; and many, unless it be checked by medicine, pass eight or ten stools, or more, in the twenty-four hours. The nature of the dejections is peculiar, and, in the great majority of cases, they are darker in colour than in health, and when the follicles are diseased contain large flakes of thickened mucus, which, floating about and deeply tinged with bile, appear like small portions of the variegated moss that grows on the tiles of houses. Frequently the stools are grumous, and, according to Louis, assume the character of coffee-grounds; while in a few cases blood is passed, and sometimes in amazing quantities, filling the chamber-vessel.

Another symptom is *meteorism*, or the effusion of air into the large intestine. This is present in a greater or less degree in one-half of the cases, and when considerable it always marks a grave affection, and one generally fatal. On the contrary, the abdominal muscles are in a few cases tense, and strongly contracted.

The above symptoms are present whether the alimentary canal be or be not inflamed; but when inflamed, as a general rule the patient experiences no pain, or only when strong pressure is made. The seat of the pain, whatever part of the alimentary canal be affected, is either immediately over the ilio-cæcal valve, or else over the epigastric region. In a very few instances the intestine ruptures, and the patient dies in great agony from peritonitis.

It is seldom, however, that the fever runs its course without greater complexity both of symptoms and of

lesion; for the brain, or the membranes of the brain, or both, most commonly become either simultaneously or consecutively affected with the alimentary canal. In these cases the symptoms which arise from their condition will be added to those already described; but it has been stated they are often present when the function of these parts is merely disordered, as well as when they are inflamed.

Inflammation of the membranes of the brain may be divided into three stages, though some one of them is often wanting. The symptoms of the first stage are severe and constant pain in the head, occupying ordinarily the frontal region; the face, sometimes pale and sometimes red, being greatly expressive of the distress the patient suffers. The eye, haggard or brilliant, with its conjunctiva injected, is painfully sensible to the light, and is, therefore, generally closed. The least noise is insupportable, and the patient is troubled with noise in his ears. His temper also is altered, and his answers short and fretful. This stage, then, is that of increased excitement, but not as yet of delirium, and, supposing the membranes to be inflamed, denotes diffuse inflammation of those tissues. At the end of a period of time, varying from two to ten days, this stage terminates, and the second stage is ushered in by the patient becoming delirious. His delirium may assume every character, and he joyous or melancholy, furious or tranquil; and in some cases he wanders from subject to subject, while in others he incessantly recurs to the same theme, and even to the same few words. In others, though the cases are few, the disease assumes every character of insanity; and, if permitted, the patient confined in a strait waistcoat presents the extraordinary spectacle of being able, in typhus fever, to walk about the wards. The phenomena of this stage show that the inflammation of the membranes of the brain has extended to the substance of the brain itself. The last stage, or that of effusion, commences by the active delirium changing into a low muttering, by the patient no longer requiring restraint, by his muscles becoming spasmodically affected with slight twitchings, or subsultus tendinum, showing how rapidly the nervous power is exhausted, and how feebly supplied; also by the pupil of the eye becoming expanded or contracted; by the fæces being passed involuntarily; by the urine being retained; and by the rapid grouping of those other symptoms so happily described by Shakespeare, as the stone coldness of the feet creeping "upward and upward," "the babble of green fields," and the "fumbling of the bed-clothes," and which indicate approaching death. When the patient recovers, however, from this stage, the appetite improves, the pulse becomes fuller and steadier, the countenance more tranquil, the mind firmer, his sleep natural, till at last convalescence is fully established.

If, in the course of the disease, the poison falls on the lungs, the symptoms denoting inflammation of these organs will necessarily be added to those of the brain and of the alimentary canal, though these latter have generally much abated at the time of this occurrence. If the inflammation be confined to the mucous membrane, the symptoms are a short dry cough, with a mucous or purulent expectoration, and perhaps mixed with blood. Should the substance of the lungs be affected, crepitation, or a loud mucous rattle, is heard all over the chest, while the countenance becomes livid and swollen, and the breathing loud and laborious,—symptoms which sufficiently denote the nature of the lesion the lungs have sustained.

With respect to the cutaneous tissue, it is sometimes dry, but more commonly the patient is covered with perspiration, which gives no relief. It should be added, that on the eruption of petechiæ or of sudamina, the disorder appears to be neither aggravated or ameliorated. The sudamina, however, in general mark a milder fever than the petechiæ.

Diagnosis.—The nature of this fever cannot be determined during the few first days of the attack; for the fever which precedes the eruption of small-pox, of a common cold, and of many other disorders, in no respect differs from that of the first stage of typhus. If, however, the fever continues unabated at the end of four or five days, and with no eruption or other circumstance to account for it, there can be no doubt the disease in question is typhus.

Prognosis.—The prognosis to be formed of typhus varies greatly according to the circumstances in which the patient is placed, and to the severity of the type. Desgenettes says, of 25,000 men who reached Torgau after the disastrous campaign of 1813, 13,448 perished of typhus in four months. At Mayence, says M. Fauverge, of 60,000 troops, 25,000, or $\frac{5}{12}$ths, died of typhus. In France, it is estimated that from one in three to one in four and a half is the proportion of deaths to attacks. In this country, it is calculated that only one falls in six or seven of those attacked. In some years, however, when the fever is mild, the recoveries are much larger; while in years in which the type of the fever is low, the ratio is much smaller. Age has a great influence over recovery. Dr. Arthur Thomson affirms that the risk of life in fever is twice as great at 31 as at eleven years old; twice as great at 41 as at 21; and five times as great at 61 as at 11 years. The following table, however, from Mr. Watts's inquiry into the mortality from fever, in the great towns in Scotland, is a nearer approximation to the solution of this problem, or—

There died per cent. of those attacked in the towns of	Under 10 Years of Age.	From 10 to 12.	Above 12.
Edinburgh . .	12 per cent.	29	70
Glasgow . .	12 ,,	29	70
Perth . . .	15 ,,	30	69
Dundee . .	19 ,,	51	48

Women are supposed to have more chances of recovery than males.

Treatment.—As typhus depends on the system being impregnated with a poison for which no antidote is at present discovered, the fever, whatever be the mode of treatment adopted, uniformly runs its course, modified only by the treatment, the season, and by the temperament of the patient.

The antidote to the poison of typhus, if it exists in nature, being undiscovered, what is the best mode of treating this formidable disease? In typhus fever there is almost uniformly present in the first stage a full pulse, an increase perhaps of temperature, considerable headache, inflammation of one or more organs or tissues, and the blood when drawn in the first stage is occasionally buffed. Ought we, under these circumstances, to bleed? To this practice, however, the experience of Huxham, Pringle, Lind, Carmichael, Smyth, Fordyce, and even of the celebrated Mr. John Hunter, is decidedly opposed; for they affirm that, although in mild cases of fever some blood may be taken with impunity, still it rarely benefits the patient, while in severe cases its injurious effects are strongly marked. In modern times, Andral has bled in

fever, but with so little success that out of 74 cases thus treated 35 died. Louis has also repeated this experiment; and he says that of 52 cases that died of fever, 39 were bled a greater or less number of times; and that the course of the disease was more rapid and fatal in proportion as the first bleeding was large and practised at the earliest period of the disease. He also adds, that the delirium was aggravated rather than relieved, and that it caused no sensible alleviation of the abdominal affection—results certainly anything but favourable. Cruveilhier also states that typhus ought not to be treated after the manner of diseases essentially inflammatory. Such is the evidence against bleeding in fever, and demonstrating that operation to be the exception and not the rule of treatment in this formidable disorder—a deduction which is perfectly in accordance with all we know of morbid poisons—it being proved by repeated experiment that when an animal is poisoned, the poison is more rapid in its course, and more fatal in its consequences, in proportion to the degree the animal has been bled.

We should therefore never forget, in the treatment of this disease, that it has a course to run; and secondly, that in most cases there is a series of local inflammations to be set up, as in cases of scarlet fever, measles, or small-pox,—inflammations which no art can prevent, and which, when moderate, render the disease both milder and safer than when such inflammations are altogether wanting; and also, that the general as well as specific actions of the poison are, for the most part, greatly increased by large bleedings, or by severe and unnecessary depletion of any kind. The utmost, perhaps, that can be said for bleeding, is, that in mild cases it may sometimes be practised with impunity.

With respect to the few positive rules in the treatment of fever, experience has shown that they vary, in some degree, according to the nature of the affections of the alimentary canal. When, for instance, the follicular structure of the intestines is inflamed or ulcerated, it seems proved by a large number of cases that a local treatment by enemata composed of decoct. hordei lb. ſs. to lb. j. c. syr. papaveris, ℥ ſs. to ℥ j. is by far the most successful treatment. These exhibited night and morning remove all those causes which can irritate the inflamed part, and thus soothe and tranquillize the system generally. In addition to this, if the abdomen should become meteorized, a large linseed poultice should be applied over the abdomen and kept on for many hours. In this form of the disease no advantage appears to have been derived from the application of leeches or blisters to the abdomen or temples. Neither has wine in large quantities been useful.

When the web of the mucous membrane is affected, or the membranes of the brain, or both, and the disease is of moderate intensity, the old method of treatment is probably to be preferred, or to give salines as long as the tongue is white, and perhaps to apply a few leeches to the temples if the eye be injected; and as soon as the tongue becomes brown, to support the patient by means of mist. camphoræ, ℥ iſs. c. sp. ætheris nitrici, ʒ j. 6^{tis} vel 4^{tis} horis, and at the same time to allow him four to six ounces of port wine with sago, strong broths, &c., daily. If meteorism should take place the linseed poultice should be applied as in the former instance.

Should the disease, however, be decidedly of a low character and bleeding out of the question, and the lungs loaded, a powerful stimulant treatment is perhaps to be preferred from the very commencement of the disease. Thus, ten grains of camphor dissolved in two ounces of gin, and given night and morning, whatever were the symptoms, was successful in many of these doubtful cases. Some, also, were treated with salicinæ, gr. v. 4^{tis}, and recovered; while, in the worst cases, ʒ j. of quinine thrown up as an injection every night often produced good effects. The linseed poultice, also, was applied with much advantage when meteorism was present.

Another practical rule in the treatment of fever is, that when the parotid glands are enlarged, the patient must be supported from the very commencement with wine, æther, broths, &c.—at least when the patient has been differently treated he has died.

In all instances the patient is benefited by checking those secretions which are in excess and restoring those which are in defect. Such are the most general rules for the treatment of typhus fever.

Dietetic and Preventative Treatment.—The patient's diet should be strictly farinaceous, with the addition of broths and subacid fruits throughout the whole course of the disease, or until the nates, as they sometimes do, slough, and in that case a mutton chop must perhaps be prematurely hazarded; but its effects should be watched with much caution.

The preventative treatment includes the three great principles of *cleanliness*, of *ventilation*, and of *separation*. The chlorides or boiling vinegar may mask or destroy smells, but do not neutralize or destroy contagion; for when the Hôpitale Salpêtrière at Paris was used for fever patients, in the campaign of 1813, even those who superintended the fumigations fell ill of the disease. Cleanliness, such as frequent change of linen and the removal of all evacuations, are not only grateful to the patient, but, by preventing an accumulation of miasmata, are a safeguard to the attendants. Ventilation has likewise the same good results; and in every case of fever the bed curtains should be undrawn and the door or window occasionally opened for the admission of air. Cleanliness and ventilation also should not be limited to the person of the patient but should extend also to the apartment; and, on his recovering, the chamber in which he has lain should be well washed, and such parts as will admit of it be white-washed. It is owing, perhaps, to the neglect of this precaution that fever so fatally prevails in the lodging-houses of the poor. One family falls ill of fever, and another succeeds, which suffers the same fate, till the walls become impregnated with the miasmata and the apartment becomes a real focus of infection. Even where the party has a permanent habitation, but ill ventilated and dirty, the same result follows: thus, the Rookery of St. Giles's, the Mint in the Borough, and the narrow courts of Holborn and Whitechapel are hardly ever quite free from fever. In every epidemic, therefore, it is the duty of the parish authorities to see that the houses of the poorer quarters be cleansed and white-washed. Separation, however, is as necessary as ventilation and cleanliness; for when fever cases are heaped together fever of a most dangerous character prevails; and even our largest hospitals become, under these circumstances, a focus of pestilence and contagion.

Of the Poison of Scarlatina.

There are three diseases usually termed the *exanthemata*, in consequence of their principal phenomena being a very marked eruption—namely, the scarlet fever, the measles, and the small-pox. They are re

markable for being the first diseases of secondary formation we are acquainted with, being supposed to have first originated in Arabia about the middle of the VIth Century. The Arabians first described them, and considered them merely as varieties of one and the same disorder. Many essential differences, however, were soon observed to distinguish the small-pox; but the points of resemblance between measles and scarlet fever were so many, that it was not until many most fatal accidents had occurred from the great error of confounding them, that their differential characters were remarked and their separate identity established. There is one remarkable law, however, common to them all, or that the patient having once had either of these diseases is not again liable to it, his susceptibility to the poison being exhausted on the first attack. We now mean to treat of scarlet fever, a disease from which there died in 1839, in England and Wales, 10,325 persons.

Remote Cause.—The original source of the poison is distinctly traceable to Arabia; but as that country is greatly destitute of animal and vegetable matters, it seems impossible to refer its origin to any chemical decomposition of those substances. As the disease has now spread over the whole world, as it prevails at all seasons of the year, is always sporadic, and yet often epidemic, the more probable inference is that it must have a telluric origin.

Predisposing Causes.—Scarlet fever has been found to spread more extensively and with greater fatality among the poorer than among the wealthier classes of society. It is twice as fatal in towns as in the country; for in 1838 the mortality in the metropolis was 0·82 per cent., while in England and Wales it was only 0·39 per cent. Again, in 1839 it was 1·131 per cent. in the metropolis, and as 0·67 in England and Wales. Its prevalence also appears to be influenced by season,—at least if we suppose the deaths to be proportioned to the numbers attacked. Thus, in the winter quarter of 1839 there died in the metropolis 207, in the spring quarter 272, in the summer quarter 408, and in the autumnal quarter 637. Both sexes are attacked in nearly equal proportions; or in 1839 5·095 males died, and 5·230 females. All ages are probably liable to the action of this poison, but it is most common to childhood, the feebleness of this early period of life facilitating perhaps the reception of the poison.

It is a law of this disease that, once produced, the infected person of the patient generates a poison which is both contagious and infectious:

Infectious, because no susceptible person can remain in the same room, and hardly in the same house, without contracting it. The

Infecting distance is consequently much greater than in typhus. Indeed it is necessary to break up every academic establishment in which it prevails, it being hardly possible to isolate children in the same house or school, however large, so as to prevent it spreading. It is likewise

Contagious; for children have been inoculated with the serum found in the vesicles which sometimes accompany the rash, and have taken the disease; but the inoculated disease not having proved milder than in the natural way, this mode has been abandoned. Another proof of the contagious nature of scarlatina is, that it has often been propagated by

Fomites, as by the clothes and boxes of boys returning from school. Susceptible persons also sleeping in a room lately occupied by patients labouring under scarlatina, and before the furniture has been washed and the bedding and walls well ventilated, have often taken the disease.

Susceptibility exhausted.—Dr. Willan says, that out of 2000 cases that he attended, he witnessed no instance of a *second attack*. Still there are some exceptions to this law—Dr. Binns having seen instances of scarlet fever occurring twice in the same party, while Sir Gilbert Blane met with an instance of its occurring thrice in a young lady, without the least suspicion of ambiguity or possibility of mistake.

Co-exists.—Scarlet fever has often co-existed with the vaccine disease and with erysipelas, and this poison is consequently capable of co-existing in the system, not only with those that have been mentioned, but probably with all other morbid poisons.

Modes of absorption.—This poison is absorbed by the mucous membranes, and also evidently from the fact of inoculation by the skin. Children have been born labouring under this affection, and consequently the poison infects the blood.

Period of Latency.—This period varies from a few hours to ten days. In one case inoculated by Rostan, the disease appeared on the seventh day. The disease is probably contagious and infectious as soon as the primary fever has formed, and perhaps till the sore throat has perfectly healed, supposing that affection to continue after the eruption has died away.

Pathology.—The theory of this disease is, that the poison having been absorbed, mingled with the blood, and its period of latency completed, acts upon the great nervous centres, deranging their functions, and producing fever. This fever, termed the primary fever, having lasted 24, 48, or 72 hours, does not subside, but the secondary actions of the poison are set up as the peculiar eruption followed, preceded, or accompanied by a sore throat. The eruption runs a given course of six to eight days, but the duration of the affection of the throat is more indefinite, and varies from eight to twenty, or more days. The fever continues during the eruption, and as long as the sore throat exists, but these being terminated, it now subsides, and the disease is ended. In a few instances, however, tertiary actions succeed, as dropsy or inflammation of the joints, diseases quite as formidable as any which had preceded them. As in ordinary fever, the poison of scarlet fever acts on the brain and its membranes, often causing the usual forms of inflammation of those parts.

The law that fever precedes the specific actions of the skin is so general that it has few exceptions, and the pyrexia has been occasionally so severe as to destroy the patient before the more specific actions of the poison have been set up. Again, the law that the great specific action of the poison is on the skin, causing the eruption or exanthema, has likewise only a very few exceptions. Of this eruption there are three kinds, termed by Frank, scarlatina levigata sive plana; scarlatina milliformis sive papulosa; and scarlatina pustulosa sive phlyctænosa vel vesicularis. These are all evanescent after death, the capillary action of the part continuing after the apparent decease of the party.

The scarlatina levigata is a smooth eruption, in which the surface of the inflamed skin presents no inequality either to the sight or touch. The scarlatina papulosa is when the papillæ of the skin are enlarged, and the

appearance is that of roughness, or of "goose-skinned." The third form is when the eruption is accompanied by a number of vesicles filled with serum, which ultimately shrivel up and desquamate.

Whatever the form of the eruption, its first appearance is that of innumerable small bright red puncta or maculæ, separated by interstices of healthy skin. These puncta or maculæ quickly become confluent, so that in a few hours the redness becomes general over the parts attacked. The colour, in ordinary cases, is in the first instance a bright red, like that of a boiled lobster, but on the decline of the disease it becomes deeper, and more resembles that of beet-root, while in severe cases it is livid and intermixed with petechiæ. But whatever tint the eruption may assume, it has this peculiarity, that it disappears on pressure, and again returns from the periphery to the centre on that pressure being removed. The colour is also always brighter and more vivid in the flexure of the joints and about the hips and loins than over the rest of the body. The termination of this inflammation is generally by desquamation, and occasionally the squamæ are so large as to preserve entire the whole epidermis of the palms of the hands and of the soles of the feet. Frank has even seen them come away with the hair, nails, and even verrucæ attached. In a few instances, however, the termination is by ulceration.

Whatever be the colour or description of the eruption, it does not attack all parts of the body simultaneously, but appears partially or in a succession of crops; or on the first day it spreads universally over the face, neck, and upper extremities; on the following day over the trunk, but is less general on the back than on the abdomen; and, lastly, on the third day it has extended itself over the lower extremities. The duration of each crop is about three days, when it disappears, and in the order of attack, fading from the head and upper extremities on the fourth day; from the trunk on the fifth day; and from the lower extremities from the sixth to the eighth day. The order of attack, however, which has been mentioned is not constant, for in some few instances the eruption appears first on the trunk and lower extremities, and only on the second day very faintly on the face and upper extremities.

The poison as frequently falls on the mucous membranes of the eyes and nasal fossæ as on the skin, and excites a similar eruption over those parts; at first consisting of a similar distinct punctuated or dotted appearance, which changes in a few hours to one diffuse red. The inflammation of the ocular membrane, however, has this peculiarity, that it does not distress the sight, for the eye bears light without inconvenience, and in no case is it suffused with coryza. Neither is sneezing a consequence of the affection of the nasal membrane; and only in a few severe cases is there any discharge from the nostril. As the eruption attacking these parts generally appears with, so does it generally die away with, the first crop of the exanthemata of the skin. This inflammation usually terminates by resolution; but in a few instances the alæ of the nose ulcerate, and sometimes mortify.

The lingual and buccal mucous membranes are also often the seat of a similar exanthema, presenting nearly the same appearance as in other parts. The papillæ of the tongue, however, are singularly elongated and enlarged, and stand up salient and erect, and of a deep scarlet colour above the thick white mucus which coats the lingual membrane, and hence the term "strawberry tongue." This affection lasts longer than the former, and usually terminates by resolution, though in a few instances the buccal membrane ulcerates and mortifies.

The sore throat, or inflammation of the faucial membrane, though not so constant an affection as that of the skin, yet, when it does exist, is often of much longer duration, and is a much graver disease, and it may either precede all the other symptoms, or else occur at any period of the fever. This inflammation, at first punctuated, then diffuse, usually runs into ulceration; and the character of the ulcer is so completely in unison with the state of the constitution as to enable us, according as it is slight or severe, to divide scarlatina into two great varieties, or into scarlatina mitior and into scarlatina gravior. The first, or sthenic form, is marked by a greatly enlarged or swollen state of the tonsils, which are of a vivid or bright red colour; and, when ulceration takes place, the ulcers are seldom deep, or the sloughs slow to come away, but usually separate about the fifth or sixth day, so that in mild cases the sore throat is healed about the eighth or tenth day, or in more severe ones about the fifteenth or twentieth. In malignant cases, or in scarlatina gravior, the tonsil is much less tumefied and enlarged, but is much more loaded with blood, and is of a deeper and sometimes of a livid colour. The ulcers also are deep and formidable, and the sloughs are thrown off later in the disease. They are likewise slow to heal, or not till the end of three weeks, or in severe cases not till four or even six weeks have elapsed, during which period the fever continues and the patient lies in considerable danger.

The inflammation of the throat may extend to all the neighbouring parts, and an abscess may form in the pharynx, or pus issue from the ears; the tympanum has been eroded, and in a few instances the inflammation has extended to the larynx, and the patient has died of croup. Besides these disorders the glands of the neck often enlarge and occasionally suppurate, and, singular to say, sometimes not till after the sore throat has healed, and sometimes when there has been no previous affection of the throat, as if these parts were the seat of a specific action of the poison.

The inflammation of the cutis, as also of the buccal mucous membrane, is usually accompanied by some inflammation of the sub-cellular tissue. This affection takes place as soon as the rash appears, and causes the hands to swell, so that the patient is unable to bend his fingers, and his face also becomes tumefied and painful. The serum effused, however, is in mild cases absorbed, and the disease terminates without any unpleasant consequence. In severe cases, however, it has a tendency to terminate in ulceration or in mortification. In one child the toes of the right foot had sloughed off; in another the integuments of the leg mortified from the knee to the foot; while, in a third, mortification commenced in the upper lip, and spread till one-half the cheek was eaten away. Some have been known to die of mortification of the rectum, and others of a similar affection of the pudenda.

Such are the primary and secondary affections of scarlatina; but this poison has also some tertiary actions, as on the cellular tissue, causing dropsy, and on the synovial membranes of the joints.

The dropsy which sometimes occurs after scarlet fever must be considered as a tertiary action of the poison. This usually commences between the fifteenth

and twenty-third day of the disease, and almost uniformly not till after all the other symptoms have subsided. It begins with anasarca of the face, afterwards attacking the hands and feet. In some instances the anasarca is universal, the whole cellular tissue filling so rapidly as sometimes to destroy the patient in a few hours, the cavities of the chest and abdomen frequently filling at the same time. When the patient has fallen from this dropsy the kidneys have in general been found healthy, although albuminous urine has been secreted during life.

The inflammation of the synovial membranes has been described by Withering, Sennertus, Heberden, Murray, and others. This disease may attack the wrist, ankle, or knee-joints, and usually terminates by effusion of serum; but in two cases that died at the London Fever Hospital the joints contained pus. This inflammation seldoms occurs till after the eruption has subsided, and is therefore the result of a tertiary action of the poison.

Such are the morbid appearances which have been observed in scarlatina, and with sufficient constancy to be attributed to a specific action of the poison; but these appearances are only to be found when the disease is of moderate intensity and the patient survives some days, for in severe and rapid cases the patient dies, not from any organic lesion, but from the intensity of the poison,—for Bretoneau, Tweedie, and Sims all speak of having examined the bodies of persons who have fallen early in the disease, in which there was scarcely any appreciable lesion. Besides these lesions peculiar to the action of the poison of scarlatina, must be added those inflammatory appearances of the brain and its membranes which are common to fever generally.

Symptoms.—The varieties of scarlet fever arise out of the law, that poisons may exhaust themselves on one or more tissues they affect without involving the whole series. Thus, the poison of scarlet fever usually acts on two membranes, or on the skin and mucous membrane of the fauces; but its actions may be limited either to one or the other of these membranes. Assuming, then, that the term scarlatina should be applied to the most usual form of the disease, or to the affection of the two membranes, the classification of the varieties would be thus—

Scarlatina,
Scarlatina sine eruptione,
Scarlatina sine angina.

Scarlatina also may be either mild or severe, and hence we have the gradations of—

Scarlatina mitior, and
Scarlatina gravior.

Scarlet fever, of whatever description, essentially consists of fever and certain local inflammations; but among the more striking phenomena of this disease, as in typhus fever, is the sudden and remarkable depression of the moral and physical powers of the body which the poison produces,—a depression so great as sometimes to cause the death of the patient in a few hours, without any re-action or any very sensible local lesion of the throat or other part being discoverable after death. On the contrary, there are a few instances in which the re-action is so great as to destroy the patient in an equally short time, and with a similar absence of all pathological phenomena, the affection of the skin being suppressed, the sore throat wanting, and the patient falling as from an overwhelming poison.

The symptoms of scarlet fever under ordinary circumstances may be divided into three stages. The first stage occupies the period from the commencement of the disease till the appearance of the eruption, and is technically termed the "*primary fever.*" The second stage, that from the appearance of the eruption till its entire subsidence; while the third stage is reckoned from the disappearance of the eruption till the termination of the disease. The duration of the first stage is twenty-four, forty-eight, or seventy-two hours; that of the second from six to eight days; while the third stage may either not exist, or vary from a few hours to two or three weeks, making the whole duration of the fever to vary from eight to thirty or more days. These stages are not, as in typhus, usually marked by changes of the tongue, for, except in scarlatina gravior, it continues coated with a white mucus throughout the whole course of the disease. In scarlatina gravior, however, it becomes brown or black in the second or at the commencement of the third stage.

The primary fever may be sudden in its attack, or the patient may complain for some days of slight indisposition. Its symptoms, whatever be the variety, are those of the first stage of typhus,—as headache, pains in the back and loins, loss of appetite, sickness, and white tongue. Still there are symptoms which distinguish it from ordinary continued fever, for the pulse, instead of being full and strong, is small and weak, and rapid, and the heat of the skin more ardent, and these phenomena continue through the whole course of the disease. The fever varies, however, greatly in intensity, or from a mere febricula to the severest forms of typhus.

Scarlatina sine angina is the simplest form of scarlet fever, and is limited to the fever and eruption, without any affection of the throat.

The symptoms of this variety are extremely mild, so that the patient is frequently not confined to his bed. The primary fever, except that the pulse is rapid, is little more than a mere febricula, and is not aggravated on the appearance of the eruption. The eruption appears at the end of twenty-four or forty-eight hours, and the crops follow each other according to the usual order of succession, appearing first on the face and neck and upper extremities; on the following day on the trunk; and on the third day on the lower extremities, when the disease has reached its acmé. On the fourth day the rash begins to decline, and fades from the face, neck, and upper extremities; on the fifth day it disappears from the trunk; and on the sixth or seventh day it is evanescent over the whole body. The colour of the rash is always more florid during the night than in the day, and on its declining desquamation takes place. With the disappearance of the rash the fever of this variety ceases, and the disease terminates; but it often leaves the patient in a state of considerable debility for several days.

Scarlatina sine eruptione.—In this form of the disease also the specific action of the poison is limited to one tissue, or that of the throat, the eruption on the skin being altogether wanting.

There is seldom a season in which scarlatina has been in any degree epidemic, that cases have not occurred in which patients not having previously had the scarlet fever are seized with severe fever and sore throat, unaccompanied by any eruption, and who, on subsequent exposure to the contagion of scarlatina, have been found insusceptible of the action of the poison; and hence it is inferred the disease they have passed

through, must have been a variety of scarlet fever or scarlatina sine eruptione.

This disease therefore essentially consists in fever and sore throat. It has been stated that the state of the throat was constantly in unison with the state of the constitution, and consequently this form of disease, according to its severity, assumes all the symptoms which accompany scarlatina mitior or scarlatina gravior, with the exception of the absence of the eruption. It seems unnecessary therefore to give a separate detailed account of this variety.

Scarlatina Mitior.—The essential character of this variety is, that the secondary or specific actions of this poison fall on two tissues, or on the skin and on the mucous membrane of the eyes, nose, mouth, and fauces. This form is liable also to the tertiary actions of the poison, but in what proportions have not as yet been determined. It is distinguished from scarlatina gravior by the more enlarged and hardened state of the tonsils.

The fever which precedes the eruption in scarlatina mitior lasts from 24 to 72 hours. The symptoms, however, are more violent than in the preceding species; for nausea or vomiting, great restlessness, headache, and some delirium frequently occur as early as the second day. The heat of the skin also is more considerable, and often raises the thermometer as high as 105°, while the pulse is quick, feeble, and fluttering, and shows the extreme debility the poison has occasioned. The primary fever having lasted its period, the specific actions of the poison are set up, and the eruption runs the course which has been described in scarlatina sine angina, but its colour is more intense, its duration more variable, and its attack more partial.

The *angina*, so marked a symptom in this affection, may precede the primary fever, may commence with the eruption, or may occur at some later day in the disease. It has many grades, and in this form of scarlatina they are all sthenic. Thus, in slight cases the throat has merely the sensation of roughness, with some pain in deglutition; at a higher degree the tonsil is enlarged and ulcerated; while in cases of still greater severity they are swollen to a degree almost to occlude the fauces. In this latter case the act of deglutition is not merely painful, but in many instances impossible, and impeded by a thick viscid mucus, which frequently requires the effort of vomiting to remove. The irritation of the fauces is sometimes propagated to the larynx, and the patient is hoarse or inaudible, and perhaps ultimately falls from this new affection. The parotid and submaxillary glands also often enlarge, sometimes previously to the sore throat, more commonly about the fifth day, and again after the sore throat has healed. In a case recently treated at St. Thomas's Hospital, these glands, singular to say, began to enlarge about the 14th day, without the patient having had any antecedent or accompanying sore throat, as though this affection was the result of a specific action of the poison.

The degree of fever is usually proportioned to the severity of the angina, and is accompanied by headache and sometimes by delirium. It does not abate on the appearance of the eruption, but continues till the throat is healed. If the sloughs come away early, or on the fourth or fifth day, the throat heals, and the fever perhaps subsides within a day or two after the eruption. It sometimes happens, however, that the sloughs do not separate till the fourteenth or fifteenth day; and in this case the fever runs on with equal violence after the disappearance of the eruption, and the whole disease is sometimes prolonged for three weeks or a month. In this case the tongue may become brown or dry, but it seldom continues so for more than a few hours.

Scarlatina Gravior.—The specific actions of the poison in this form of the disease are the same as in scarlatina mitior, but the symptoms, both local and general, are more severe, and the tertiary affections more frequent, and consequently the disease is more grave and the danger more formidable.

The more remarkable symptom which distinguishes this form of the disease is the state of the tonsils. In the scarlatina mitior it has been stated that the tonsils are either slightly affected or greatly enlarged, of a bright red, and the ulcers comparatively superficial; but in this severer form the tonsil, though less swollen, is more gorged with blood, more livid in colour, while the ulcers are foul, deep, and burrowing; the secretions of the mouth also are more copious, and generally impregnated with the offensive sordes of the sloughs; while deglutition, if less difficult, is perhaps infinitely more painful, and the mouth often so tender that the slightest touch excoriates it. The ulcers likewise are slow to granulate, and only heal after a fearful struggle; and in the worst cases they spread in every direction, and the parts vesicate and mortify previous to the death of the patient.

The eruption also offers some peculiarities, being often later, by some hours, in coming out, its colour darker and more livid, its duration more uncertain, and its distribution more irregular and capricious than in scarlatina mitior. The primary fever likewise is usually longer, the delirium earlier, and the depression more complete than in the milder forms, and towards the close of the disease the tongue becomes brown, and the symptoms closely resemble those of the last stage of typhus fever.

Such are the more marked characters of scarlatina gravior; but it often happens that the progress of this disease is silent, slow, insidious, scarcely marked by any prominent symptom, till the degree in which the constitution is subdued by this formidable poison is shown by the inflamed nasal membrane discharging its fatal ichor, causing mortification of the alæ of the nose, or else mortification of the lip or cheek, or else it seizes on some remote part, as the toe, the leg, or the whole of a lower extremity, and which for the most part terminates the life of the patient.

The tertiary actions of the poison of scarlatina are inflammation of the joints and dropsy, and it is singular that these diseases are more often set up after mild than after the more severe forms of this fever. In a few cases, then, about the time of the disappearance of the rash, the joints of the wrist or fingers, of the knees or other articulation, become swollen and inflamed, and present all the phenomena of an attack of acute rheumatism. This affection keeps up the fever and prolongs the whole duration of the disease for many days beyond the usual period.

Again, in a given number of cases, not exceeding three per cent. in general, but in different seasons, or under different treatment, sometimes amounting to twenty per cent., the tertiary action of the poison produces dropsy. This disease usually occurs about the twenty-second or twenty-third day, or about the time when the patient is convalescent, and more often after a mild than after a severe disease, Dr. Wells never having seen it follow "the putrid sore throat." This affection more commonly begins with œdema of the face,

then the hands and feet swell, and, in a few cases, the trunk and lower extremities become enormously distended, and the patient presents a frightful appearance. When the cellular tissue is thus slightly or more generally distended with fluid, effusion may take place into the cavities of the head, chest, or abdomen. When the brain is threatened, the effusion is commonly preceded by the usual hydrocephalic headache, by convulsions, and sometimes by blindness. Effusion into the cavity of the chest or of the abdomen causes the usual symptoms of hydrothorax and of ascites, which have been described, and need not be repeated. In the former instance, however, the water is sometimes poured out so rapidly as to destroy the patient in a few minutes or in a few hours.

The first appearance of the œdema, whatever form of dropsy may follow, is usually preceded or accompanied by an accelerated pulse, by the urine being scanty, commonly turbid, and passed with pain; the quantity, however, is shortly increased; and if examined when passed copiously, it is found to be of low specific gravity, or from 1·011 to 1·017, and to contain albumen.

Diagnosis.—The only diseases with which scarlatina can be confounded are the acute forms of roseola and measles. Roseola, though usually accompanied by fever and sore throat, yet is distinguished from scarlatina by the eruption being confined generally to the chest. The diagnosis between measles and scarlatina will be better understood after the laws of measles have been described, and will therefore be best treated of in the diagnosis of *measles*.

Prognosis.—The mortality from scarlet fever varies greatly according to the season, and also perhaps according to the *treatment*. In some years the proportion of deaths is not greater than three per cent.; but Sir Gilbert Blane says his practice gave one in four; but he probably was consulted only in the worst cases, for in the same year it appears, from the reports of other practitioners, the deaths varied from one in six to about one in thirty, according, perhaps, to their different modes of treatment.

Treatment.—Scarlet fever being evidently accompanied by many highly inflammatory symptoms, the practice of bleeding was adopted on the first breaking out of the disease in all countries, and, according to Willan, with the most disastrous results. The practice of bleeding was adopted by Morton; and he speaks of witnessing 300 deaths from scarlatina in a week. It prevailed also down to the times of Huxham, who abandoned it and introduced a treatment by bark. In this manner an entirely opposite system of treatment has been introduced, and the records of medicine enable us to state the results of these opposite modes of treatment: Of 121 cases treated at the Foundling Hospital

	Died.
by bleeding, in 1786.	19
60 cases treated at the London Fever Hospital in 1829, in the same manner	10
181	29

or 1 in 6 nearly.

		Died.
200	treated by wine, mineral acids, &c.	2
160	ditto by purgatives and emetics	16
50	ditto ditto	3
45	ditto ditto	1
100	wine and mineral acids	3
555		25

or nearly as 1 in 22.

It seems therefore proved, that one in six has died after bleeding, while only one in twenty-two has died after a milder, if not a directly opposite, mode of treatment; and the conclusion which inevitably follows is, that the chances of recovery are diminished by the practice of bleeding nearly in the ratio of four to one as compared with the chances of recovery, supposing the patient not to have been bled. It remains now to give some general directions for the treatment, and to point out the circumstances in which bleeding, purgatives, wine, and tonics may be most advantageously employed.

It should be laid down as a maxim, that in scarlatina medical advice ought always to be had recourse to; for the worst cases we meet with, as mortification of the nose, cheek, or limb, are those in which the disease has, from its apparently mild character, been left to itself.

In the scarlatina sine angina, the mildest form of the disease, it is often sufficient to confine the patient to the house; to strictly enjoin a milk diet; to regulate the bowels; and, above all things, to avoid the nimia diligentia medicorum. If anything more be done, a small quantity of wine and water, proportioned to the age of the patient, is the best. The disease thus treated is uniformly mild, and when the rash declines the fever subsides, and the disease is at an end.

The treatment of the scarlatina sine eruptione is the same as that of the two following varieties, or that of the scarlatina mitior and the scarlatina gravior.

The treatment of scarlatina mitior, or when the tonsils are considerably enlarged, is first to tranquillize the stomach and allay its inverted action when vomiting exists, either by small doses of the sulphate of magnesia or by the effervescing draught,—medicines which, according to the state of the bowels, may be exhibited every four or every six hours. As soon as this object is effected, and it is ascertained that the tonsils are greatly enlarged and swollen, the practice, supposing the patient to be an adult, is to relieve them by a local bleeding, and twelve to fifteen leeches should be applied to the throat, and allowed to draw freely, and this bleeding may be further encouraged by the application of a poultice. The trifling loss of blood thus sustained does not impair the general strength of the patient, while it greatly reduces the swelling of the tonsils and prevents their becoming permanently enlarged. Another advantage is also gained by the application of leeches to the throat, namely, that they relieve the affection of the head; for we constantly, in diseases depending on morbid poisons, often relieve the head by relieving the part specifically acted upon.

The tonsils having been relieved, the fever may now be permitted to run its course little influenced by medicine, and the patient only refreshed by the occasional exhibition of the saline draught so grateful to his parched mouth and feverish state. For in these cases if we stimulate the patient, we only bring back the tumefaction of the tonsils; while, on the contrary, if we take more blood we hazard producing the more serious accidents incident to scarlatina gravior. The medicines, therefore, that have been mentioned should be persevered in till the disappearance of the eruption, and till the healthy granulations of the throat and the decline of the fever give the certain evidence of a state of convalescence. At this point perhaps some mild tonic medicine, as the infusi aurantii c. tinct. aurantii, is desirable, and prepares the patient once more for the fullest

enjoyment of health. This is the most successful treatment of scarlatina mitior.

The scarlatina gravior is characterized by the less swollen state of the tonsils; by their being more livid and gorged with blood; by the ulcers being deeper and more spreading; and by the slough being fouler than in the former variety. In this form, as there is a greater tendency of parts to run into mortification, the necessity of adopting a more stimulating plan of treatment, and one more calculated to support the powers of the constitution, is manifest, and experience has shown this view of the case to be correct. A treatment by wine, which is much more easily digested than most medicines, therefore should be the basis of the cure. The quantity of wine for an adult is from four to six ounces in the twenty-four hours, and for the child about half that quantity. The wine may be either port or sherry, and should be drank in small quantity, mixed with two-thirds water; or it may be given with sago, arrow-root, or other slop. The earlier the wine is given in the disease the better, and when delirium does or does not exist, or whether the tongue is moist and white, or brown and dry, and it should be continued till the patient is decidedly convalescent, and even for some time after. While pursuing this plan it is necessary that the patient's bowels should be attended to. This treatment by wine is extremely successful; and, as it is in general pleasant to the patient, whether a child or an adult, it is seldom refused. Most persons, however, are fond of medicine, and have great faith in it; and in these cases an equivalent may be substituted, as the disulphate of quina, gr. j. to gr. ij. 6^{tis} horis, or the infusi aurantii c. tinct. aurantii, ʒ ifs. 6^{tis}, or salicinæ, gr. v. 6^{tis} vel 4^{tis}. The decoctum cinchonæ c. acidi sulphurici dilut. ♏v. to x. 6^{tis} horis, is also another efficient remedy.

In cases where, from the state of the throat, it is difficult to decide whether the treatment by wine or by leeches should be adopted, the former is always preferable; for, in case of error, it is easy to detract blood, but we cannot with the same certainty give the patient power.

The treatment of the tertiary affections of the poison is very various. Thus the affection of the larynx is one of the most important; and it is singular that although this affection would seem to be of an inflammatory character, yet bleeding is not successful in combating it; on the contrary, the most beneficial mode of treatment appears to be that of moderately supporting the powers of the patient by wine and mild tonics.

Again, when the synovial membranes inflame, and the joints become enlarged and swollen, all stimulus should be withdrawn; but bleeding in this instance also appears unnecessary; a moderate action, however, of the bowels should be kept up by means of the sulphate of magnesia ʒ fs. to ʒ j., out of camphor mixture; and, should the pain be severe, some opiate should be added, as ♏ xv. of the tinct. hyoscyami. Mr. Murray thinks so lightly of this affection that he says it was commonly removed in Aberdeenshire by warm fomentations.

The more formidable affection in scarlatina is dropsy; and from the great tendency to effusion into the head and chest, an active treatment is necessary. We should have imagined that in dropsy, a symptom in most cases of great debility, and following a disease whose characteristic is great depression, bleeding would have been dangerous and improper; but experience has shown that bleeding is at all times a prudent, if not a necessary measure: as soon, therefore, as œdema appears in the face, especially if accompanied by headache, some blood should be taken, or from 2 to 4 ounces in the child, and from 8 to 12 ounces in the adult. The rest of the treatment consists in purging the patient. The choice of the purgative must rest with the practitioner; but the bitartrate of potash in ʒj. doses three times a day is among the most useful; digitalis also is much recommended, but it does not possess any specific virtue. When the danger is passed, 5 grains of salicine, or 5 to 10 grains of the tartrate or citrate of iron may be added to each dose of the salt.

Blisters have been much recommended as a means of relieving the throat, but their value is not yet determined. Some writers speak of mortification and death following their application, while others consider them as powerful auxiliaries. As a general principle they are unnecessary, and are better omitted; since the irritation they occasion may predispose the cervical glands to the tertiary action of the poison.

Gargles are unnecessary for children, for they cannot gargle, and they are rarely necessary for adults.

Dietetic and Preventative Treatment.—The diet of the patient should be slops, light nutritious broths, and jellies. Fumigation will not, it should be remembered, destroy the miasmata in the sick room; and consequently the doctrine of cleanliness, of ventilation, and of separation, are as imperative in this disease as in typhus. We cannot disinfect the walls of the chamber, nor the clothes of the patient, except by washing them, or else exposing them to a dry heat exceeding the boiling temperature. In general, then, the chamber where the sick patient has lain should be white-washed and well scoured after the disease has subsided, before any person susceptible of the poison be allowed to sleep in it.

Of the Poison of Measles.—Morbilli.—Rubeola.

The measles are a continued febrile disorder, with certain local lesions, but more especially a peculiar inflammation of the skin, which runs a given course. This poison has the property of exhausting the susceptibility of the constitution to its action on the first attack. The number of persons that died of this disease in 1839 in England and Wales was 10,927.

Remote Cause.—The measles appeared at the same time and in the same country with scarlet fever, and have subsequently followed the same laws, namely, they now prevail all over the world, are little influenced by season, are constantly sporadic, and occasionally epidemic. Their poisons, it would appear, must consequently have a similar or telluric origin.

Predisposing Causes.—Measles, though incident to every period of life, are most frequently contracted in childhood, when it is difficult to trace the effects of accidental circumstances, so that our knowledge of the predisposing causes are most imperfect. Both sexes, however, appear to be equally liable to this affection. With respect to the influence of season, it is generally supposed that measles break out in the beginning of winter, increase till the vernal equinox, and then die away towards the summer solstice. The deaths, however, from this disease, registered in England and Wales in the years 1838, 1839, and 1840, show that the influence of season is exceedingly trifling. Thus there died in—

	January February March	April May June	July Aug. Sept.	Oct. Nov. Dec.
Deaths from measles in 3 years.	6932	7157	5543	6945

It is admitted by all authors that a patient labouring under measles generates a poison which is both infectious and contagious.

Infectious.—This disease, like scarlatina, is greatly infectious; and in like manner no susceptible person can remain in the same room, or even in the same house, without hazard of taking the disease. In the year 1824 it was imported into Malta by some children belonging to the 95th regiment, and spread extensively in that island, so that many natives died. This circumstance was the more remarkable, as the measles had not been seen in the island for many years. The *infecting distance* of this poison, it will be plain from what has been stated, must be considerable; indeed it is impossible to isolate it in our public schools or other large establishments.

Contagious.—The contagious nature of measles has often been proved by healthy children having been inoculated either by blood drawn from the arm of a measly patient, or else with serum taken from the vesicles which are occasionally found intermixed with the eruption,—an experiment which appears to have been first made by Dr. Home, with a view to producing a mild disease but as no such result has been obtained; the practice has been abandoned.

Fomites.—This disease is also propagated by fomites. The strictest demonstration of this law is, that the disease has been communicated by direct application of substances impregnated with the virus, in the attempts to inoculate for the measles; it is also proved by the clothes and boxes of children sent home from schools, where the disease has raged, communicating the disease; and also by the same circumstance resulting when susceptible children have lain in the same beds, or in the same room, shortly after it has been occupied by measly patients.

Susceptibility exhausted.—The morbillous poison having once produced its specific effects, as a general principle leaves the patient exempt from all liability to a second attack. This law may be considered as proved both by Willan and Rosenstein—the former affirming that after an attention of more than 20 years to eruptive complaints, he had not met with an individual who had twice had "febrile rubeola;" while the latter states, that in a practice of 44 years he had met with no instance of a second infection. There are, however, occasional exceptions to this law; one whole variety of this disease, or the rubeola sine catarrho, is supposed to afford no protection against an attack of the rubeola vulgaris. There are many exceptions also to the non-susceptibility of persons who have passed through the rubeola vulgaris, for Burserius, Robedieu, Home, Baillie, Rayer, and Holland have all seen instances of a second attack of the measles in the same individual.

Period of Latency.—The period of latency of this poison is determined to vary from 10 to 16 days. It seems also determined that the contagion of measles is generated as soon as the primary fever is established, and before the eruption appears.

Pathology.—The theory of measles is, that a poison is absorbed and infects the blood, and after a given period of latency acts on the great nervous centres, producing a continued fever, which does not remit on the appearance of the eruption, but runs on throughout the whole disease. The fever thus being established at the end of three, more generally of four, and in some few instances of five days, a certain secondary or specific inflammation of the skin and of the mucous membranes of the eyes, nose, mouth, fauces, and bronchi is set up in addition to the fever. In a few cases the poison has certain tertiary actions, and produces inflammation of the substance of the lungs, or of the pleura. As the primary fever lasts from three to five days, and the eruption from six to seven days, the whole duration of the disease is from nine to twelve days. Whenever the tertiary actions occur, the disease is much prolonged.

The law that fever precedes the specific actions of the poison has scarcely a recorded exception; and consequently, though the pyrexia may greatly vary in intensity, it is uniformly present. The fever which precedes the local lesions is termed the primary fever.

The second great law of the poison, or that its secondary actions are on two membranes, or on the skin and mucous membranes, has some exceptions; for the affection of the mucous membrane is entirely wanting in one variety, or in the morbilli sine catarrho. The law that the poison produces certain tertiary actions, as inflammation of the lungs, or pleura, is so well determined that it requires no proof, but we must regret that their proportional frequency is not ascertained.

Since the affection of the skin is uniformly present, while that of the mucous membranes is sometimes absent, the cutaneous eruption is necessarily the great characteristic of the disease; but the morbillous eruption being evanescent after death, we can only imperfectly trace its pathology. It first appears as a circular dot, similar to a flea-bite, slightly prominent, and sensible to the touch. Its colour is of a deep raspberry hue, and in rare instances, as in the morbilli nigri, is livid or black. In severe cases, also, especially if the patient be of tender age, the exanthema assumes a papular form, and when at its height, occasionally a vesicular form; and the latter is most common on the arms, the neck, or the breast. The colour of the exanthema is evanescent on pressure, but returns on the finger being removed.

The patches of the exanthema are extremely numerous, so that they leave little of the healthy skin intervening between them; and they not unfrequently become confluent, and form large maculæ, sometimes of a semi-lunar form. The principal seats of the exanthema are the face and back, while the parts least affected are the pudendal and popliteal regions. The inflammation attending the exanthema extends in some degree to the subjacent cellular tissue, for the face is tumid and swollen, but not so as to close the eyelids.

The eruption does not at once cover the whole body, but consists of three crops, each of which follows the other at an interval of twenty-four hours, the duration of each crop being three to four days. The course of the measles then is, that on the third or fourth day of the primary fever the first crop appears on the face, neck, and upper extremities; on the following day, the second crop covers the trunk; and on the third day the third crop appears on the lower extremities, so that the whole body is full of the eruption, which is now at its

height. On the following day, the fourth of the eruption, the exanthemata begin to decline from the face, neck, and upper extremities; on the following day they fade from the trunk; and on the sixth or seventh day, they are evanescent over the whole body. They uniformly terminate by resolution, followed by a furfuraceous desquamation of the cuticle of the body generally.

The inflammation of the mucous membrane, of the eyes, and nasal fossæ, generally commences either with or before the primary fever, and consequently precedes the eruption by some days. This inflammation is perhaps for a few hours puliose, then diffuse, but quickly changes to the serous; for a profuse watery discharge from the eyes and nostrils shortly follows, termed the "coryza." This affection usually continues till the decline of the eruption, and in some cases later.

The mucous membrane of the mouth and fauces also inflames, but the inflammation differs from that of the eyes and nose in not being accompanied by any discharge. In other respects it is exactly similar to the cutaneous eruption, for a number of exanthemata, more or less confluent, are seen upon the palate, uvula, tonsils, and velum pendulum palati, and they equally terminate by resolution. They appear also at the same time with the eruption on the face, neck, and upper extremities, but do not decline till the eruption fades from the body generally.

The bronchial and tracheal mucous membranes are usually attacked, either before or at the same time with the buccal membrane, but whether the inflammation of which they are the seat is marked by the same characteristic eruption is not determined, for few patients fall at this early period of this disease. The cough and expectoration, however, which accompany it are constant, and the latter shows that it partakes of the same serous character as that of the nasal and ocular membrane. Again, towards the close of this disease, or even as late as the third or fourth day after the eruption has disappeared, the poison not unfrequently falls on the substance of the lungs or pleura; supposing it to fall on the substance of the lungs, it usually excites serous inflammation of that tissue, and the quantity of fluid effused is frequently so considerable as to stream from the lung as soon as its tissue is divided. In severe forms of the disease the poison may produce either the red or grey hepatization of the lung, but these results are rare. The pleura does not at all times escape the action of the poison; and the diffuse, the serous, the adhesive, and even the purulent inflammation may invade that tissue, and either destroy the patient or prolong his convalescence. Diarrhœa also is often an accompaniment of this disease, which renders it probable that the mucous membrane of the intestines may be the seat of a specific action of the poison.

Symptoms.—The symptoms of the measles result from the fever, and the consecutive local lesions. The varieties of the disease, however, are extremely few, for no instance is known of a morbillous fever without the secondary or specific actions following; but the poison is supposed sometimes to limit its action to one membrane, or to the cutis, and to exhaust itself on that tissue; and hence, the morbilli sine catarrho. The varying intensity also of the morbilli enables us to divide them also into two grades, or into the morbilli mitiores, and into the morbilli graviores. The arrangement, therefore, of the forms of this disease will be as follows:—

Morbilli sine Catarrho.—Morbilli mitiores.—Morbilli graviores.—The primary fever may make its attack suddenly, or be preceded for a few days with symptoms of a common cold, and in general the latter is the case; but in no instance is the primary fever, which is afterwards prolonged, and accompanies the eruption at any time, of great intensity; for although many fall from the severity of the local lesions, yet no instance is known of the patient being overwhelmed or destroyed by the general depressing action of the poison, as in typhus fever or in scarlatina. The depressing powers of the poison, however, are considerable, and are always sufficient to confine the patient to his bed for a few days, and to leave him, for a short time after the disease has subsided, weak and debilitated. The type of the fever of measles consequently greatly differs from that of typhus or of scarlatina, and the formidable brown tongue, so grave a symptom in the latter, is hardly known in the former, or only seen in a few fatal cases.

Morbilli mitiores.—The essential characters of this affection are, that the poison produces primary fever, and a specific inflammation of two membranes, as of the skin and mucous membranes, the fever not subsiding till the eruption dies away.

The symptoms of the measles may be divided into three stages; the first embraces the primary fever, or the period before the eruption, and may last from three to five days; while the second stage embraces the period of the eruption, and lasts from six to seven days. These two stages very commonly comprise the whole disease, whose usual course is from nine to twelve days. The third stage includes any inflammatory action which may be caused by the tertiary action of the poison, and therefore only occasionally exists.

The early symptoms of the primary fever are seldom severe, and greatly resemble those of an ordinary but severe catarrh. They are shivering, alternated with heat, frequent pulse, headache, derangement of the bowels, sometimes accompanied by nausea and vomiting; and these affections are so considerable that the patient usually takes to his bed. At the end of a few hours the fever becomes continued, and the specific action of the poison commences by the mucous membrane of the eyes and nose inflaming, so that the light is painful; the senses of smell and taste are lost, and this is followed by a copious discharge of serum from the nose and eyes.

The buccal and bronchial membranes may become affected at the same time, and the patient is then troubled with a frequent cough, which, according to Frank, has this peculiarity, that it occurs in paroxysms. The cough does not remit till about the seventh day, and is often accompanied by hoarseness, by a sense of constriction across the chest, by diarrhœa, and sometimes by ischuria. The duration of this first stage is three, four, or five, and Home states he has seen it last six days.

The second stage commences with the appearance of the eruption whose course and character has been described. On the appearance of the eruption the fever is often aggravated, but the distressing nausea and vomiting seldom last beyond the fourth day. The fever, therefore, together with the coryza, sneezing, coughing, hoarseness, and diarrhœa, continue with unabated severity till the eruption has reached its height, and is full out over the whole body, which is on the third or fourth day after its first appearance. From this period, in

favourable cases, all the symptoms begin to decline; and on the eruption disappearing the cuticle desquamates, and the disease terminates on the ninth, tenth, or eleventh day from its commencement

In a few cases, however, on the subsiding of the eruption, or about the ninth, tenth, or eleventh day of the disease, and in some instances earlier, the tertiary actions of the poison are set up, and inflammation of the substance of the lungs or of the pleura takes place, prolonging the duration of the disorder, and endangering the life of the patient. The inflammation of the bronchial membrane is denoted by the expectoration either of a thick viscid mucus or of pus, and which may or may not be streaked with blood, while the mucous or sonorous rattle will point out the peculiar seat and extent of the mischief. If the substance of the lungs be inflamed the breathing is more difficult, the cough more troublesome, and the countenance livid; but the loud mucous rattle which accompanies it seldom allows us to hear crepitation, or to determine the absence of respiration in any given portion of the lung. If the pleura be inflamed, we have, in addition to the cough, severe pain in the side—the *point de côté*, and the impossibility of filling the chest, except in a very limited degree; and this is often accompanied by dulness on percussion, by bronchophony or ægophony, assuring us that fluid is effused into the cavity of the chest.

Morbilli graviores.—The characteristic of this severe form of measles is the exanthemata becoming suddenly black, or of a dark purple with a mixture of yellow. The early writers on measles describe this form of the disease as being much more common in their times than we find it to be in the present. Sydenham considers this appearance as extremely formidable, and that persons so seized are irrecoverably lost unless they are immediately relieved by bleeding and a cooler regimen. Willan says he has seen this discoloration, but thinks more lightly of it.

Morbilli sine catarrho.—When the measles have been epidemic, a few cases have been observed in which the fever and cutaneous eruption have constituted the whole disease; the mucous membranes being altogether free from coryza or other form of inflammation. Frank rejects this form as spurious, because it does not protect the constitution from a subsequent attack of the more ordinary form of measles.

Diagnosis.—The diseases with which measles may be confounded are scarlet fever and some forms of syphilitic eruptions. The diagnostic symptoms between measles and scarlet fever are numerous, for there are many differences both in their general laws and particular symptoms by which they may readily be distinguished. Thus, the periods of the latency of their poisons are different, that of scarlet fever being from two to ten days, while that of the measles is from ten to fourteen days. The exanthema in scarlet fever seldom appears later than the second day of the primary fever; in the measles it is delayed till the fourth day. In scarlatina the patches of the exanthema are large, and the surface they cover ample; but in measles they are not larger than flea-bites, and when most confluent the clusters are small. Their colour is also different, being of a bright red in scarlet fever, while in measles it partakes more of a raspberry hue. The affections of the mucous membranes are also different in the two diseases. In scarlatina the tonsils are almost constantly greatly enlarged and ulcerated, while in measles they are little or not at all affected. In scarlatina the eyes are free from coryza, while in measles that is the most prominent symptom. The tertiary actions of the poison are also different, being, in scarlatina, inflammatory affections of the joints, and dropsy; while in measles they are inflammations of the lungs or pleura; and, lastly, in measles the fever usually subsides on the disappearance of the eruption; but in scarlatina the fever often continues many days or weeks after the eruption has run its course, or till the sore throat has healed.

Prognosis.—The mortality from measles greatly varies in different years. Percival says, that out of 3807 cases of measles, 91 died, or 1 in 40. Watson says, that in one year, at the London Foundling Hospital, 1 in 10 died; and in another, 1 in 3. In the same establishment also in 1794, out of 28 cases none died; in 1793, out of 69 cases 6 died; in 1800, out of 66, 4 died; and the aggregate of these data will give as an average of 1 death in 15: so that the prognosis in every case of measles is favourable. The prognosis, however, is more favourable in the country than in the metropolis; for it appears by the registrar-general's report, that in the year 1839, the proportion per cent. of the population that died of measles in London was as ·107; while, in England and Wales, it amounted to no more than ·071.

Treatment.—The measles differ from scarlet fever not only in the fever being much less depressing, but in their running a shorter or more definite course, and in their having no tendency to terminate in ulceration or mortification. The measles, therefore, though depending on a morbid poison, approximate to the phlegmasiæ compared with scarlet fever, for the constitution is little impaired by the short continuance of the disease, and consequently they admit of a more strictly antiphlogistic treatment.

As no antidote is known to the poison of the measles, the disease will run its course whatever treatment we adopt. The rule of treatment, therefore, is to interfere as little as possible as long as the disease is safe, and merely to moderate symptoms when they threaten danger, and to subdue them, if possible, when danger really appears.

The *morbilli sine catarrho* are usually so mild a form of disease as to require no other treatment than a milk diet and the customary attention to the bowels. In the *morbilli mitiores*, however, the cough, the frequent vomiting, and the heavy catarrhal symptoms which so generally attend the primary fever, render medical attendance necessary from the first moment of the attack. The treatment of these symptoms, however, and also of the eruptive stage, as long as the patient continues free from any serious inflammatory affection of the lungs, need not necessarily be active, it being sufficient to alleviate the cough, allay the vomiting, and check the catarrh by some of the large class of neutral salts which afford so many useful remedies. In making our selection from these we must be principally guided by the state of the bowels and the condition of the stomach. If the bowels be constipated, the milder purging salts, as the sulphate of magnesia or the sulphate of soda in ℥ fs. or ℥ j. doses ex. mist. camphoræ 6^tis^ vel 4^tis^ horis are to be preferred. On the contrary, if the patient be purged, and the vomiting distressing, the mist. potassæ citratis effervescens is the most beneficial. There are many persons in whom the cough and catarrhal symptoms are the most urgent, and in such cases, if the stomach be quiet, the liquor ammo-

niæ acetatis in ℥ ſs. doses ex. mist. camphoræ, from its more powerful action on the skin, is an excellent substitute. Another remedy equally or perhaps still more useful, is ipecacuanha, of which, gr. j. vel gr. ij., may be given 6^{tis} vel 4^{tis} horis. Some practitioners prefer antimony to ipecacuanha, but antimony appears, at least in large doses, to act in some instances perniciously on the lung.

The treatment which has been specified is, in many cases, all that is necessary throughout the whole course of the disease; and the greatly extended experience of Willan has hardly enabled him to enlarge it. He thinks, however, that an emetic given on the second or third evening *somewhat* alleviates the violence of the catarrhal symptoms, and contributes to prevent the diarrhœa which usually succeeds the measles. During the eruption, he adds, "I have not observed any considerable effect from antimonials or other diaphoretics." Bathing the feet every evening seems a more beneficial application. Emulsions and mucilages afford but a feeble palliation of the cough and difficulty of breathing. With respect to opiates, Sydenham gave an opiate every night throughout the whole course of measles; but in the early stages, according to Willan, it produces an increase of heat and restlessness without conciliating sleep.

The catarrhal symptoms are frequently accompanied, even in the very earliest days of the disease, with much bronchial inflammation, and sometimes with pneumonia; or these affections may occur at any later period after the decline of the eruption, or from the tenth to the twelfth day of the attack. This great tendency to pneumonia has caused the question to be agitated, whether bleeding ought not to be adopted as part of the treatment of this disease in all cases, either as a means of cure or as a precautionary measure, or whether it should be reserved until the pneumonic symptoms are present. Experience has shown that bleeding may be practised with impunity in the very first onset of the disease, or at any subsequent stage. Willan, however, is of opinion that it is very rarely necessary to bleed before the subsidence of the eruption; for, if we wait that event, we "usually find the pulse become moderate, and the uneasy, laborious respiration terminate in 24 hours. This oppressed breathing is common to other eruptive fevers; and if it were universally to be considered an indication for bleeding, the practice would often be more fatal than the disease." If, however, pneumonia or pleurisy be clearly established, blood should be freely, but not extravagantly, taken; for it should be remembered that although some children bear the loss of blood well, yet that others are long in recovering from it even when the quantity drawn is small. In children, then, below 10 years of age it is more prudent to take blood frequently and in small quantities than in a large quantity at once. We should likewise be content with moderating the symptoms, for, as the inflammation depends on a morbid poison, it has a course to run, and does not admit of a sudden cure. The bleeding should also be more moderate during the eruption than after it; for we have a right to look for a diminution of all the symptoms when it disappears. Blisters, ipecacuanha, and mercury, are amongst the best adjuvantia to bleeding in these cases.

During the whole course of the disease it is necessary to enjoin an abstinence from all animal food, and to limit the patient to a low diet and to slops. The chamber should be of a moderate temperature, and not subject to any sudden change from heat to cold, and the strictest cleanliness should be observed. In large establishments separation is necessary to prevent their spreading.

Of the Small-pox or Variolæ.

The small-pox consists of a remittent fever, of an eruption which runs a given course, and of certain occasional tertiary affections. This poison has the property of exhausting the susceptibility of the constitution to its future action on the first attack. In the year 1839 there died of this disease, in England and Wales, 9131 persons.

Since the first appearance of the small-pox at Mecca, two great epochs have occurred in its history. The first is the discovery of the singular and beneficent law, that the destructive agency of this poison is greatly mitigated by introducing it into the system by means of the cutaneous instead of the mucous tissues, or of *inoculation;* and, secondly, the still more wonderful fact, that the vaccine poison, though differing in many of its laws from the variolous poison, has the extraordinary and unlooked-for property of protecting the constitution, and rendering it altogether insusceptible to the action of that deleterious agent.

Remote Cause.—The same obscurity hangs over the remote cause of small-pox as over those of measles and of scarlatina. While, however, the causes of these two latter diseases seem still active, there is every probability that of small-pox has subsided, and that this disease has now no other source than human contagion. It is singular, however, if depending on human contagion, it should still occasionally assume an epidemic character—a circumstance, perhaps, owing to the gradual accumulation of susceptible unprotected persons. In whatever manner this poison is produced, season does not appear greatly to influence its ravages; for according to the registrar-general's report, there died in 1840, in the winter quarter, 2071 cases; in the spring quarter, 2476; in the summer quarter, 2274; and in the autumnal quarter, 3613.

Predisposing Causes.—There are so few persons susceptible of the poison who escape infection, when exposed to its influence, that the subject of predisposing causes has not been much studied. There are circumstances, however, not easily appreciable which do predispose to this disease; for example, a gentleman long accustomed to frequent the small-pox hospital, and even to make drawings from the deceased with impunity, at length took the disease from being accidentally in the same room with a variolated corpse. A nurse, also long attached to that hospital, and in constant attendance on the small-pox patients, went into the country for a short recreation; but on her return she became infected, and passed through the disease. This susceptibility or insusceptibility to the poison depends partly on the constitution and partly on accidental circumstances. Mr. Hunter states he inoculated a number of slaves off the coast of Africa, and that those that took the disease before the Harmattan all did well, but such as were not seized with the symptoms when that wind began to blow, and they were sixty in number, never felt any other than a slight nausea and fever during the continuance of the wind. After, however, it had changed, the small-pox appeared in twenty, but

the others were obliged to be re-inoculated, when they all did well.

Both sexes and all periods of life are equally liable to this affection. The ages, however, at which persons are attacked, as deduced from the ages at which they have died, of the small-pox, are as follows:—

Elementary Principles of Medicine.

Deaths of Males and Females from Small-pox.

Months Old.	Died.	Years Old.	Died.	Years Old.	Died.	Years Old.	Died.	Years Old.	Died.
0	202	0	2,235	10	226	40	43	75	4
1	181	1	1,524	15	226	45	22	80	10
2	162	2	1,197	20	240	50	13	85	1
3	456	3	869	25	148	55	10	90	0
6	646	4	628	30	93	60	19	95	1
9	588	5	1,122	35	75	70	10	Unknown	8

The small-pox once engendered, the person of the patient generates a poison which is both *infectious* and *contagious*.

Infectious.—This disease is so infectious, that not only is it unsafe for a susceptible person to be in the same room, or in the same house, with a party labouring under the disease, but it has often been caught by passing a child in the small-pox in the street, and even on the other side of the way; so that "to expose a person in the public highway, infected with this contagion, is considered a common nuisance, and indictable as such." The dead body of a variolated person is equally infectious, and students, who have merely seen it when brought into the dissecting-room, have in consequence fallen ill of the disease. The *infecting distance*, therefore, must be many yards around the patient's person: indeed, with every precaution, there is great difficulty in preventing it spreading from ward to ward, even in large hospitals.

Contagious.—The fact of the contagious nature of small-pox has been fully demonstrated by the once general practice of inoculation; and the poison by this operation has been proved to exist in the serum, in the pus, and in the crusts of the small-pox pustule. There is no law more singular and unexpected, in the whole range of morbid poisons, than that the introduction of the variolous poison, by means of the cutaneous tissue, should produce an infinitely milder disease than when the same poison is absorbed by a mucous tissue. It appears essential, also, that it should pass *through* the skin; for when the puncture has been made deep, so as to see "a bit of fat," the disease which has ensued has hardly been mitigated. The contagion, per

Fomites, besides being shown by the practice of inoculation, has been demonstrated by the disease spreading almost all over the continents of Africa and of America, by the transmission of an infected blanket, or other article of clothing. One lady caught it by putting on a shawl worn by her friend, who had just fallen ill of the disease. Dr. Gregory mentions the wife of a registrar-general, with whom he was sitting, taking the disease from a nurse who came to announce the death of a parishioner by the small-pox, the contagion being brought, as is supposed, in the woman's clothes.

The length of time fomites may remain infected may be seen from the fact of the Hindoos seldom inoculating but with matter a twelvemonth old.

Susceptibility exhausted.—The small-pox has the property, in common with measles and scarlet fever, of exhausting, on the first attack, the susceptibility of the constitution to the future actions of the poison. This law, however, is not without some exceptions, and in the late epidemic at Marseilles, Bousquet considered one person in one hundred was attacked a second time with small-pox. In some few instances even a second attack has no protective influence. Dr. Roupel says he met with an instance in which small-pox occurred three times in the same person. The lady of a Mr. Guinnett had it five times. Dr. Maton speaks of a lady who had it seven times; while Dr. Baron mentions a surgeon of the South Gloucestershire militia, who was so susceptible that he took the small-pox every time he attended a patient labouring under that disease.

Co-existing.—The variolous poison is capable of *co-existing* with many other poisons, and also of influencing their actions, and of being reciprocally influenced by them. Dessessarz has seen variolæ co-exist with scarlatina and with hooping-cough; Cruikshanks with measles; Frank with psora; and Dimsdale with syphilis. A patient was admitted into St. Thomas's Hospital with tertian ague; the ague subsided and the small-pox appeared. The small-pox having run its course, the ague immediately returned. Ring mentions a case of triple disease co-existing, or of small-pox, measles, and hooping-cough, and they all ran their course together.

The reciprocal influence, however, of the variolous and the vaccine poisons over each other is among the most remarkable phenomena incident to morbid poisons; for the poisons being introduced into the system together, the one disease may precede the other, or they may co-exist. But either disease having run its course, the constitution, as a general law, is protected not only against the action of the poison that produced it, but also against the action of the other poison. Thus, a patient having had the small-pox is guarded not only against the small-pox, but also against the cow-pox; and, on the contrary, the cow-pox poison guards the constitution against the cow-pox, and also against the small-pox. There are many exceptions, however, to this law, which will be shown when treating of the vaccine disease; but still the exceptions are too few to invalidate the general principle, or to render the practice of vaccination less advisable and less practically useful.

The variolous poison, it will have been seen, may be introduced into the system either by a mucous membrane or by the cutaneous tissue, and that when introduced by the mucous tissues, it always produces a disease of great malignity and frequent fatality, or the *natural small-pox*. While, on the contrary, when introduced by the cutaneous tissue, or by *inoculation*, it almost always produces a mild disease, rarely attended by any

fatal result. In whichever way, however, it is introduced it infects the blood. The proof of this law is, if blood be taken from a patient labouring under small-pox, and be injected into the veins of a dog, the animal dies, although a similar injection of healthy blood would not be attended with any inconvenience. A stronger proof, if possible, is, that many children have been born covered with the small-pox eruption; and it is remarkable that this pathological phenomenon has taken place, not only when the mother has been labouring under the disease, but also when she has been entirely free from it. In some cases there has appeared reason to believe that the child must have gone through the disease while yet in utero; while Dr. Jenner thinks he has seen cases in which the child must have been infected in utero, and so lately that the disease has appeared within a few hours after birth.

Period of Latency.—The variolous poison having infected the blood, lies in latent combination with that fluid a period of time which varies according to another remarkable law, or according as the poison has been introduced by the mucous or cutaneous tissues. In the former case, or in natural small-pox, for example, the more usual time of latency is from ten to sixteen days, while in the inoculated small-pox the period of latency is only from seven to nine days. The extremes, taking both forms of the disease, being from five to twenty-three days. It is not yet determined at what period this poison is first generated by the patient's person, or whether, during the primary fever, or not till after the eruption has appeared; but, as in measles, it is probably secreted during the primary fever.

Pathology.—The theory of the small-pox is, that a poison is absorbed and infects the blood, and after a given period of latency, gives rise to "primary fever," which lasts from two to four days, till the eruption appears, when it for the most part *remits.* The eruption, or secondary, or specific action of this poison affects the skin, and also the mucous membrane, of the eyes, nose, of the mouth, and of the fauces. It runs a given course of vari,* of vesicle, and of pustule, and when full out, or at its height, the febrile phenomena, which had remitted, return, and give rise to what is termed the *secondary fever.* The tertiary actions of the poison are inflammation of the various tissues of the lungs, affections of the urinary organs, and lastly of the cellular tissue of the body generally, which often becomes the seat of an endless number of abscesses.

The law, that fever precedes the secondary or specific actions of the poison, or the appearance of the eruption, has scarcely an exception, and indeed in some instances it has been of so severe a character as to have destroyed the patient on the first onset. The remission or subsidence of the fever is also constant in mild cases, but in the severer forms of the confluent small-pox it sometimes runs on, and is constant. The recurrence of the "secondary fever," and the exacerbation of the fever in severe cases at the time of the maturation of the pock, is also constant. The cause of this secondary attack has long been a difficulty in the history of small-pox, some attributing it to a remittent nature of the fever, while others consider it to result from the maturation of the pustules, and to be a *suppurative* fever. The former, however, seems the most probable explanation.

The second great law of small-pox, or that the secondary actions of the poison occasion a peculiar eruption, has only a few rare exceptions, or the variolæ sine eruptione. With that exception the eruption is uniformly present; but the affection of the mucous membranes is often wanting in mild cases, though rarely absent in severe ones. The law also that the poison produces many tertiary actions, as inflammation of the lungs, of the urinary organs, of the eye, and of the cellular tissue, is generally admitted. These actions, however, are often wanting in mild cases, and it is to be regretted that the proportionate frequency of their occurrence is not determined.

The small-pox pustule, which is the great characteristic of the disease, runs a given course of about eleven days, and in its progress undergoes many mutations, being at first tubercular, then vesicular, then pustular, and lastly it forms the scab or crust. These various changes form so many stadia of unequal duration. The first, or tubercular stage, lasts from twenty-four to forty-eight hours; the second, or vesicular stage, four days; the pustular stage three days; while the last stage, or that of scabbing, lasts three days more, making the whole duration of the *normal* pustule ten or eleven days. There are varieties, however, of this disease, in which the formation of the pustule is irregular, as in the *confluent* and *horn* small-pox, and in the latter the two last stages are singularly shortened, or else absent altogether.

The distinct small-pox, then, consists, on the first appearance of the eruption, of a number of small red tubercula or vari, about the size of a pin's head, more or less numerous, but separate and distinct from one another, and scarcely salient. On the second or third day the second stage commences, and a small vesicle, which gradually enlarges, bound down and depressed in the centre, or *umbilicated,* forms on the apex of each varus, and contains a clear whey-coloured fluid. This stage lasts about four days, when the pustule maturates. This process is so gradual, that Dr. Watson says, if you examine the pustule closely about the fifth or sixth day you may see, at least in many, two colours, viz. a central whitish disk of lymph, set in, or surrounded by, a circle of yellowish puriform matter. "In truth, there is in the centre a vesicle, which is distinct from the pus, so that you may puncture the vesicular portion, and empty its contents without letting out any of the pus, or you may puncture the part containing the pus and let that out without evacuating the contents of the vesicle." While this change also is going on, a damask red areola forms around each pustule, and as the vesicle fills the whole face swells, and often to so great a degree, that the eyelids are closed. When the maturation is complete the "*bride,*" which bound down the centre of the vesicle, ruptures, and the pustule now becomes spheroidal or *acuminated.* About the eighth day of the eruption a dark spot is seen on the top of each pustule, and at that spot the cuticle ruptures, and allows a matter to exude, which concretes into a scab or crust, and during this process the pustule shrivels and dries up. This crust is detached between the eleventh and fourteenth days, leaving the cutis beneath of a dark reddish brown, a discoloration which lasts many days or weeks. On the face, however, the pustule often penetrates or burrows, so as to cause ulceration of the rete mucosum, and to leave a permanent depression or "pit," greatly disfiguring the person. The cicatrix formed on filling up of these ulcers, though at first of a reddish-brown, is ultimately a dead white colour.

The small-pox eruption does not appear over the

* Varus, a small tumor.

whole body at once, but, like the other exanthemata, appears in three successive crops. The first crop covers the face, neck, and upper extremities, the second the trunk, while the third appears on the lower extremities. There is usually an interval of several hours between each crop, and by how much the later the pustules are in appearing on the trunk and lower extremities than on the face and neck, by so much the later they are in maturating and in disappearing from those parts.

The number of pustules is very various, sometimes not exceeding five or six over the whole body, more commonly from one to three hundred, and occasionally amounting to several thousands. It has been calculated, if ten thousand pustules be counted on the body, that two thousand at least will be found on the face, and accordingly the number of pustules on the face being in proportion those on the other parts of the body, is a fair estimate of the extent of the disease, and of the danger of the patient.

The pustule is subject to many irregularities, both as to its form and course, and which give rise to two very marked varieties of the disease, or to the confluent and to the horn small-pox. The confluent small-pox differs from the distinct small-pox in the tubercula or vari being small, less prominent, and so numerous that even on the first appearance of the eruption there is hardly any distinct separation between them. The vesicles which form on their apices appear earlier, and their diameters increase more irregularly than in the distinct forms, and often they run one into the other. The pustules likewise, which are confluent, either remain flat and do not rise, or else, the cellular tissue rupturing, they form large bullæ or bladders, (variolæ corymbosæ) and are not encircled with the usual red areola round their base; neither do their fluid contents always acquire the yellow colour and thick purulent consistency of the milder disease. Their crusts, moreover, are soft, and do not fall off till many days after the usual period, or not till the eighteenth or twentieth day, or even later; and when the desiccation is completed and the crust detached, a deep scar or pit, sometimes an extensive seam, shows the destructive ulceration that has taken place beneath them.

The horn small-pox is a variety of the distinct small-pox, and is by much the mildest form of the disease. The pustule in this variety passes through the stages of vari and of vesicle, but on the fifth or sixth day of the eruption, instead of maturating, the pustule shrivels, desiccates and crusts, and the disease terminates three or more days earlier than the usual course, and without the occurrence of any secondary fever. This is the form of the disease which so usually follows after vaccination.

Many other varieties have been described by the old masters: Sydenham, for instance, speaks of a black small-pox; Mead, of a blood small-pox; Friend, of a siliquous small-pox, in which the pustule resembles a small hollow bladder, but contains no fluid. These varieties of the pustule were probably occasioned by improper treatment, or by some rare idiosyncrasy of temperament, and are consequently not mentioned by modern writers. There is one variety, however, which is not uncommon, which is the crystalline or pearl pock (*variolæ crystallinæ*), in which the vesicle continues transparent, seldom maturates, and has a tendency to become confluent. Every variety of the eruption, also, when the disease is severe, may be intermixed with petechiæ.

The cutis is more particularly the seat of the variolous eruption; but let the affection be at all severe, the mucous membrane of the conjunctiva, of the palpebræ, of the nasal fossæ, of the mouth, and of the pharynx, are covered with it. The variolous poison consequently produces an eruption on two classes of membranes, or on the skin, and on the buccal and facial mucous membrane. It has been much disputed whether the eruption forms on any other of the mucous membranes, and as a general principle it does not; but Martinet found, in a man that died on the eighth day, the rectum covered with variolous pustules. Rostan has seen the alimentary canal garnished with pustules similar to those of the mouth, from the œsophagus to the rectum. Sir Gilbert Blane also met with pustules on the mucous membrane of the intestines in two cases that died in the West Indies: and Rayer has given a plate representing pustules on the mucous membrane of the trachea. Dr. Mead's experience has made him state that, "I myself have seen subjects in which the lungs, brain, liver, and intestines were thick beset with pustules." Dr. Pitzholdt, in the morbid anatomy of small-pox, says he has seen the peritoneum covering the liver and the spleen, presenting appearances which he felt justified in regarding as the product of the small-pox.

The pustules which form on the mucous membranes have not been very distinctly studied either as to their course or phenomena. Rayer terms them *rudimentary* pustules; they probably, however, undergo the usual mutations of vari, of vesicle, and perhaps of pustule; but their course is shorter than when they occur on the skin; neither do they crust, although they sometimes run into ulceration.

Salivation is a common symptom in small-pox; but whether the salivary glands are affected in consequence of an extension of this inflammation, or from a tertiary action of the poison, is not determined. The small-pox having been chiefly studied previous to any sound knowledge of morbid anatomy, or of the laws of morbid poisons, its tertiary actions are as yet but imperfectly known; but about the eighth day in the distinct, and the eleventh day in the confluent small-pox, a secondary fever is established, and at the same time a new series of phenomena present themselves in a few severe cases,—as affections of the lungs, of the urinary organs, or of the cellular tissue of the body generally.

The most frequent affection of the lung is hæmoptysis, but occasionally inflammation of those organs takes place. The mucous membrane, for instance, of the trachea is found often covered with a thick semi-purulent muciform matter, peculiar to small-pox, irregular or honey-combed at its free surface, and which being removed, the subjacent tissue is found diffusely inflamed. The substance of the lungs also is occasionally found inflamed in every degree, even to purulent infiltration. The pleura also, according to Dr. Gregory, is peculiarly disposed to inflammation, which comes on about the eleventh or twelfth day, for the most part very suddenly, proceeds rapidly to empyema, sometimes destroying the patient in thirty-six hours. The pleura does not merely run into suppuration, but takes every other form of inflammation to which it is at any time liable.

The tertiary action of the variolous poison on the urinary organs and on the uterus is seen in the frequent occurrence of hæmaturia, and in the occasional formation of abscess of the kidney; while its action on the uterus is manifest from menorrhagia in the unimpreg-

nated state, and also of frequent miscarriage when the patient is parturient.

The cellular tissue of the body generally is also acted upon by this poison. In two cases examined a few hours after death, the bodies could with difficulty be laid on the table, the skin being detached by the pressure necessary to raise them; the serous coat of the intestines also separated from the mucous and muscular coats with the greatest facility for many feet, and apparently could have been entirely peeled off. In one of these cases, also, the finger could be thrust through the walls of the heart with ease, as if the muscles of that organ had become unnatural, soft, and broken down. This affection of the cellular tissue generally also is seen in the great tendency in some cases to the formation of abscess on the subsidence of the eruption; for 20, 30, and even more small abscesses will sometimes form on a limb or other part of the body in most formidable succession, and which, being opened, are found to contain a sanies, or, only in a few instances, laudable pus.

The different lesions that have been mentioned are not the only miseries from which the patient may suffer; for these are often followed by sequelæ even more formidable than the preceding phenomena, as blindness, deafness, or lameness. With respect to blindness, it is generally supposed that pustules form on the conjunctiva or cornea, the inflammation then extending to the deeper-seated parts, and thus destroying the eye. Mr. Marson, however, surgeon to the Small-pox Hospital, says that, according to his experience, "the eye seems to possess a complete immunity from the small-pox eruption, and that although it sometimes extends to the inner margins of the eyelids, the particular local affection that causes the destruction of the organ of vision in variola begins generally on the 11th or 12th day, or later, from the first appearance of the eruption, and when the pustules in every other part of the body are subsiding. It comes on after the secondary fever has commenced, with redness and slight pain in the part affected, and very soon an ulcer is formed, having its seat almost invariably at the margin of the cornea. This continues to spread with more or less rapidity, and the ulceration passes through the different layers of the cornea, until the aqueous humour escapes, or till the iris protrudes. In the worst cases there is usually hypopion, and when the matter is discharged the crystalline lens and vitreous humour escape. In some instances the ulceration proceeds very rapidly; I have more than once seen the entire cornea swept away within 48 hours from the apparent commencement of the ulceration; and what is singular, now and then the mischief goes on without the least pain to the patient, or his being aware that anything is amiss with his eyes." This gentleman calculates that in 1000 cases 26 had ophthalmia, or about 1 in 39, and of these 11 lost an eye each, or 1 in about 100.

The inflammation of the buccal membrane may extend to the Eustachian tube, causing suppuration of the ear, and sometimes permanent deafness. It may spread also to the glottis; and the patient has been known to die suffocated by effusion into the cellular tissue around it, causing occlusion of the aperture. Sometimes it has terminated in ulceration, with the loss of a portion of the nose, or in a caries of the jaw-bone, or in enlargement of the glands of the neck.

Such are the pathological phenomena of the small-pox. Death, however, according to the experience of Jenner, Mead, Maitland, and others, has not unfrequently anticipated their action, and destroyed the patient during the primary fever, and before any of them could be set up.

Symptoms.—The species of small-pox are the natural small-pox, the inoculated small-pox, and the small-pox after vaccination. Of the natural small-pox there are three varieties, or the variolæ sine eruptione, the variolæ discretæ, and the variolæ confluentes.

Symptoms of the variolæ sine eruptione.—Sydenham and Frank have observed in every variolous epidemic, that some few persons who have not previously had the small-pox, or, according to Frank, have neither had the small-pox nor been vaccinated, are seized, during the time the small-pox is raging, with all the symptoms of primary variolous fever, and which having subsided, they have afterwards been found insusceptible of the disease. Sydenham states that he has seen fatal cases of this kind attended with purple spots and bloody urine; and hence the variolæ sine eruptione.

Symptoms of the variolæ discretæ.—Of the variolæ discretæ there are two varieties, or the variolæ discretæ, and the variolæ discretæ verrucosæ.

The symptoms of variolæ discretæ, or of distinct small-pox, may be divided into three stages. The first stage comprises the primary fever, which commences with the disease and terminates with the appearance of the eruption. The second stage commences with the eruption and terminates with the appearance of the secondary fever. The last stage commences with the secondary fever, and includes all the subsequent phenomena.

In the adult the symptoms of the first stage are not to be distinguished from those of the first stage of typhus; but in children there is a greater tendency to vomiting, and the brain also is more oppressed with drowsiness, stupor, or coma, and followed occasionally by convulsions. Sydenham says, when children, especially after dentition, are seized with convulsions during the primary fever, it is a sign the eruption will shortly appear. The ordinary duration of this fever is four days, and it may be sudden in its attack, or be preceded by some days' illness, in which case the most prominent symptoms often are severe muscular pains similating rheumatism.

On the fourth day inclusive from the first attack of the primary fever, sometimes sooner, and but seldom later, the eruption appears, and the second stage commences. The phenomena of the second stage are as a calm succeeding to a storm; for, on the appearance of the eruption, the fever remits, the heat abates, the affection of the head subsides, the vomiting ceases, and the pulse returns to its natural standard, and consequently the febrile phenomena have altogether disappeared.

The number of pustules varies, according to the severity of the case, from 20 to some thousands. They appear, as has been stated, in a succession of crops, or first on the face, neck, and upper extremities; then on the trunk, and lastly on the lower extremities, and run the course, and undergo the various mutations of varus, vesicle, and of pustule already described. About the eighth day of the disease, however, or when the eruption is fullest out over the whole body, and the pustules of the face begin to maturate, the whole face, head, and neck swell, particularly the eyelids, which often close and blind the patient; the swollen parts also throb and are painful when touched. The intumescence of these parts lasts three days, during which the spaces between

the pustules inflame, and are of a deep red or damask-rose colour, and the closer this resemblance the milder the subsequent affections.

It is during this period of intumescence that the fever which had remitted returns, and the third stage, or that of secondary fever, commences. This attack, in cases of ordinary intensity, is marked by a considerable increase of heat, by a frequent pulse, and by slight delirium, from which the patient is easily aroused. If, however, the disease be of greater intensity, hæmaturia, hæmoptysis, or a hard dry cough are added. In favourable cases, the swelling of the face, the redness of the intervening spaces, and also this secondary fever, having lasted from the eighth to the eleventh day, subside, and the pustule, now fully ripe, bursts and discharges a thin yellow matter, which, concreting into a crust, falls off on the fourteenth or fifteenth day, and the disease terminates.

When, however, the disease assumes an unfavourable character, and threatens a fatal termination, the face, which ought to have been intumescent on the eighth day, remains without increase of size, and the spaces which ought to have inflamed are pale and white. The pustules also, says Sydenham, look red and continue elevated, even after death, and the sweat, which flowed freely up to this day, suddenly ceases. At this critical period the secondary fever, instead of its usual sthenic character, may assume one of two forms, or that of the second stage of typhus, with brown tongue, frequent pulse, and delirium, or else the patient may be overwhelmed with the depressing influence of the poison, and sink almost without experiencing a re-action, the pulse being hardly increased in frequency, the heat of the body natural, and the intellect unimpaired. But the patient suffers from an indescribable restlessness, an inexplicable anxiety, some cough, with sickness, a frequent desire to pass urine, and with these symptoms he dies after a short struggle.

In cases of any degree of severity, even in the variolæ discretæ, the poison acts not only on the skin but also on the buccal and ocular membrane, and produces an eruption of pustules on those parts. This additional affection, however, does not appear to aggravate the fever, or to occasion other inconvenience than what arises from the local disease. The buccal eruption is usually preceded and accompanied by soreness of the throat and difficulty of swallowing; but these symptoms do not exceed those of a common sore throat. The pustules also, which form within the eyelids, are not attended with much pain, and it is only when the swelling has subsided that the mischief which sometimes takes place is discovered.

Symptoms of the variolæ discretæ verrucosæ, or horn small-pox.—The symptoms of this variety are similar, but milder than those of the preceding disease, for the primary fever is little more than a febricula; the pustules do not exceed half a dozen to two or three hundred, and having passed through the stages of varus and of vesicle, they on the eighth day, or about the usual time of maturation, shrivel, desiccate, and crust. The secondary fever also, often so fatal, does not recur, so that the convalescence usually commences on the eighth day, and the disease is terminated on the eleventh.

Symptoms of the variolæ confluentes.—The confluent small-pox is described by Sydenham as beginning with symptoms similar to those of the distinct small-pox, but more violent. The first stage, or primary fever, being attended with more sickness and vomiting, with greater heat, with more severe muscular pain, with more considerable delirium, and in children often on the evening before the eruption by convulsions. This fever is not only more intense than in the distinct kind, but is also of shorter duration, the eruption appearing more generally on the third day, or even earlier; and by how much the sooner the pustules appear, by so much the more confluent is the disease that follows. The eruption is often preceded also by an extensive erythematous or erysipelatous inflammation, and the vari come out irregularly, or in small clusters, like the measles, and are less eminent than in the distinct small-pox.

When the second, or eruptive stage, is formed, the primary fever remits, but not so completely as in the distinct kind, for the pulse often continues frequent (110 to 120 in a minute), the tongue white, and even the delirium may recur in the evening. This eruption also has some remarkable characters, for the pustules, especially those of the face, do not rise, they are more irregular and flatter in their forms, and from their greater number and contiguity run into each other, or are confluent, sometimes forming bullæ as large as a hen's egg.

Another symptom also sometimes seen in the distinct, never fails to accompany the second stage of confluent small-pox, or *salivation*. The salivary discharge begins either with the eruption or within a day or two after, and is then thin and copious, resembling the ptyalism by mercury. About the eighth day, however, it becomes viscid, and is expectorated with difficulty; while in bad cases it either ceases for a day or two and then returns, or else it disappears altogether. Children are not so liable to this salivation as the adult, but in them a vicarious diarrhœa often appears, but not constantly, neither does it occur so early in the disease. It is frequently profuse, unless checked, and often proceeds till the disease terminates.

It has been stated, that on the appearance of the eruption and the commencement of the second stage, although the fever is mitigated, it does not altogether subside, but that the affection of the head, the frequency of the pulse, and greater heat of the surface, often continue. With these ominous symptoms then still present, on the eighth day of the eruption, or the 11th day of the fever, the third stage, or secondary fever, commences, bringing with it new sources of anxiety to the physician and of danger to the patient.

"The confluent small-pox," says Sydenham, "does not in the least endanger life in the first days of the illness, unless there happens a flux of blood from the urinary passages, or from the lungs. Yet, on the decline of the disease, or on the 11th, 14th, 17th, or 21st days the patient is often brought to such a state that whether he will live or die is equally uncertain. He is first endangered on the 11th day by a high fever, attended with great restlessness and other symptoms, which ordinarily prove destructive, unless prevented by medicine. But should the patient outlive this day, the 14th and 17th are to be apprehended, for a very vehement fit of restlessness comes on every day towards evening, and there is the greatest difficulty in saving him.

The fatal symptoms of the third stage are, the absence of the usual redness in the intermediate spaces, the non-intumescence of the face, the suppressed salivation, cough, with hæmoptoï, or hæmaturia, and great restlessness. Sometimes other symptoms are added to these, as a brown tongue, delirium, petechiæ, or a black

spot in the centre of each pock, scarcely so big as a pin's head, or else a disposition to gangrene in the large vesicles; and when these symptoms are present few persons survive this terrible crisis. In some cases, however, the event is favourable, and the patient is restored, but the struggle is sharp and the convalescence long, and in its progress an endless series of abscess may form, or inflammation of a joint take place and produce lameness, ulceration of the cornea, blindness, otitis or deafness, while the deeply-scarred face is a lasting record of the severity of the disease, and of the great danger the patient has survived.

Symptoms of Variolæ post Vaccinationem.—The symptoms of this form of the disease are in the great majority of cases those of the variolæ discretæ verrucosæ. In a few instances, however, they are those of the distinct and still more rarely those of the confluent small-pox; but whatever form they may assume their *comparative* mildness is their great characteristic.

Symptoms of Variolæ post Inoculationem.—The phenomena which result from the introduction of the variolous poison by means of the cutis differ in many respects from those that occur in the natural small-pox, and they are as follows:—On the day after the operation is performed, though it take effect, little alteration is discovered in the punctured part. On the second day, however, if the part be viewed with a lens, there generally appears an orange-coloured stain around the incision, while on the 4th or 5th day the part is hard, slightly inflamed, and itches, and a vesicle containing serum is formed on it. About the 6th day some pains and stiffness are felt in the axilla, symptoms which foretell the near approach of the fever and the favourable progress of the disease. On the 7th day the vesicle becomes more developed, and the red areola forms round its base.

The operation having now been performed seven, eight, or nine days, the usual period of latency of the poison, and the vesicle having existed four days, the ordinary symptoms of primary fever appear. This fever lasts three or four days, when the general eruption follows, now called the secondary eruption, the pustules coming out, as usual, in three successive crops, or on the face, trunk, and lower extremities. On the day of the general eruption the primary pustule, says Dr. Gregory, is distended with matter, and so proceeds on its course that it has scabbed when the secondary eruption is only about to maturate.

The most remarkable laws, however, of the inoculated small-pox are the singular mildness of the fever and the diminished number of the pustules of the secondary eruption. The mildness of the fever is thus instanced by the late Dr. Watson, of the London Foundling Hospital: "Of the seventy-four persons whose histories I have related, though inoculated with variolous matter in different states, although prepared in so different a manner, and a great number not otherwise prepared than by an abstinence from animal food, not one of them were disordered enough during the whole progress to occasion the least anxiety for the event; not one them had, from the pustules being upon the eye or near them, their eyes closed a single day; none continued in bed an hour longer than they would have done in their best health."

The number of pustules is subject to great varieties, but, with very few exceptions, it is much less than in the natural small-pox. In some cases not more than two or three appear, occasionally only the primary pustule is seen; but more generally the number varies from ten to two hundred, the mean being thirty or forty. Such is the general course of the inoculated small-pox. In a few instances, however, the disease that follows this operation is extremely severe, and in a still smaller number it is confluent; and in either case the patient is perhaps destroyed. Many theories have been invented to explain the singular mildness of the inoculated small-pox, but none of them are satisfactory.

Diagnosis.—It is not possible to distinguish the primary fever of small-pox from that incident to the other exanthemata, or from the first stage of continued fever. In the adult, however, the muscular pains are more severe, and in children there is a more frequent occurrence of convulsions.

The small-pox eruption, on its first appearance, is with difficulty distinguished from the varicellæ; but after a few hours its characters are so strongly marked that nobody who has seen the two diseases can confound them.

Prognosis.—The prognosis of the natural small-pox is always most grave. The calculation of the proportionate number of deaths, however, appears to have greatly varied in different years. It was formerly supposed that one in five or six attacked perished. In the present day, when the adult is almost its only victim, the records of the Small-Pox Hospital show that the loss has averaged thirty per cent., the extremes in different years being eighteen and forty-one per cent. In the epidemic of 1838,—

Of Unprotected.

	Admissions	Deaths.
Of Confluent Small-pox . .	295	149
Semi-confluent	78	8
Distinct	19	0
Total . .	392	157

Of Vaccinated.

	Admissions	Deaths.
Of Confluent Small-pox . .	56	21
Semi-confluent	42	4
Distinct	20	0
Total . .	118	25

Sydenham considered the eighth, eleventh, fourteenth, and seventeenth days were the most fatal. Dr. Gregory has given us the number of deaths that took place on each day of the eruption; in 168 fatal cases,—

First Week.	Deaths.	Second Week.	Deaths.
3rd Day . .	1	8th Day . .	27
4th ,, . .	5	9th ,, . .	15
5th ,, . .	10	10th ,, . .	14
6th ,, . .	5	11th ,, . .	16
7th ,, . .	11	12th ,, . .	11
		13th ,, . .	11
Total .	32	14th ,, . .	5
		Total .	99

Third Week.	Deaths.	Fourth Week.	Deaths.
15th Day . .	7	22nd Day . .	3
16th ,, . .	5	23rd ,, . .	1
17th ,, . .	3	24th ,, . .	3
18th ,, . .	3	25th ,, . .	1
19th ,, . .	1	27th ,, . .	1
20th ,, . .	2	28th ,, . .	1
		Fifth Week.	
Total .	21	29th ,, . .	1
		31st ,, . .	1
		32nd ,, . .	1
		35th ,, . .	1
		38th ,, . .	2
		Total .	16

In general about one in three die from confluent natural small-pox; one in ten of distinct natural small-pox; and one to three per cent. only of small-pox after inoculation or after vaccination.

Treatment.—It is admitted that no medicinal antidote exists to this poison, and consequently the rule of treatment is merely to combat adverse symptoms. As the loss in small-pox from the primary fever is extremely small, little more is necessary to be done during this stage than to keep the bowels open and to exhibit saline medicines. When convulsions occur, as they frequently do in children, Sydenham and Cullen recommend, in preference to all other treatment, a cordial and a slight opiate. In the second stage, as the fever subsides as soon as the eruption appears, and as the pulse is now quiet, and no symptom of any moment exists, there seems no reason to alter the preceding treatment.

At the commencement of the third stage, or on the eighth day in the distinct and the eleventh day in the confluent small-pox, a formidable and too often fatal crisis occurs in the establishment of the secondary fever. The treatment of this crisis, it will be seen, from the deaths from confluent small-pox at the Small-Pox Hospital having been in 1838 more than one-half of the whole number treated, must be most unsatisfactory. Some physicians have bled, some have purged, some have given wine, and others have given bark; and all have had to boast of the recovery of some patients, but the ultimate loss has been nearly the same under every practice. In general, in slight cases, the treatment of this stage may be trusted to mineral acids, as the infusion of roses with ♏ v. to ♏ x. of dilute sulphuric acid; while, in severe cases, the practice of Sydenham, still perhaps the best, should be adopted. His directions are,—"I order ten to twelve ounces of blood to be immediately taken away from that arm which has the fewest eruptions, and in which the vein therefore may be the most commodiously opened, and an opiate to be given in a large dose in the evening; and it is to be repeated morning and night from this time, and for some time oftener." The exhibition of an opiate is insisted upon in other parts of his works as an essential part of the treatment, for he says,—"It appears to me that opiates are as much indicated in the confluent small-pox as any particular remedy in any other disease, being a kind of *specific* here, as the bark in intermittent."

In the course of the disease gargles will be found very grateful to those patients whose buccal membrane is affected with the eruption. The patient also often suffers from severe pains of the legs, and this is best met by warm fomentations, or by putting the feet in warm water with or without the addition of a decoction of poppy-heads. The sequelæ of the disease, as sloughing sores, abscesses, &c., are to be treated by poultices and the ordinary rules of surgery; but, at the same time, the patient must be supported by a generous diet and by tonic medicines.

In India it is the practice to employ cold affusion throughout the disease; but Dr. Currie gives two cases in which he tried this practice, but they both died; and Rayer speaks of its aggravating the pulmonary symptoms. Other practitioners speak of enveloping the whole body in one immense cataplasm, and, it is said, with some success. Others have recommended the opening the pustules, and, by letting out the matter, thus prevent the secondary fever; but Huxham says, "a mortification is sometimes brought on" by this practice. Others have destroyed the pustule by caustic to prevent pitting, but it is generally determined that a worse cicatrix follows than if the cure were committed to nature.

The treatment of the affections of the eye is still most unsatisfactory; for the sight has been often lost when bark has been exhibited, while bleeding has not been more successful in stopping the ulcerous progress; and when we find 11 persons out of 26 have gone blind at the small-pox hospital, it is evident the local treatment of this disorder is not more advanced.

Dietetic and General Treatment.—The diet of the patient throughout the whole course of the disease should be strictly limited to slops, sago, arrow-root, and ripe fruits.

The chamber in which the patient lies should be cool, and freely ventilated. The bed-clothes should be light; the body-linen daily changed; and, when the disease is long, the patient's back should be often examined to prevent sloughing. The scalp likewise should be examined, and, if full of pustules, the hair should be cut off to prevent its matting.

There are no measures that can be relied on for preventing the spread of the disease; and if any susceptible person has been exposed to the infection, he ought immediately to be vaccinated; or, if vaccine matter cannot be obtained, he should be immediately inoculated, and in either case a mild disease will ensue.

Of the Poison of the Varicella—*Chicken-Pox*, *Swine-Pox*, *the Hive-Pox*.

The varicella is a disease consisting of fever and of an eruption, which generally runs a given course of eight or ten days. The poison exhausts the susceptibility of the patient, on the first attack, to its future actions. The name of this eruption indicates that it was for a long time considered, if not variolæ, at least of the same family. It is dissimilar, however, to that affection in the mildness of its character, in the shortness in its course, and in its failing to give any protection against the small-pox. No death from the varicella is recorded by the registrar-general as occurring in England or Wales during the year 1839.

Remote Causes.—The origin of this poison is entirely unknown, as also whether it is of primary or secondary formation; but it is probably the latter, being principally mentioned by the writers on small-pox.

Predisposing Causes.—This disease is of so little moment, that its predisposing causes have not been studied. It is, however, for the most part peculiar to childhood

and early adult age. The disease, once engendered, is both contagious and infectious.

Infectious.—The evidence of the infectious nature of the varicella is the same as that of the other exanthemata, or the spread of the disease in schools and families.

Infecting Distance.—The distance to which the poison may extend, when diffused through the atmosphere so as to induce the disease, is not determined, but it is not so infectious as the small-pox, scarlet fever, or measles, for, when it breaks out, its extension is easily controlled. The infectious spread of the varicellous miasmata is, therefore, probably inconsiderable.

Contagious.—The contagious nature of this disease has been frequently proved by direct inoculation; and several cases of its being communicated in this manner are given by Willan.

Fomites.—The propagation of the varicellæ by inoculation is a proof of the contagion *per fomitem.*

Susceptibility exhausted.—This disease, as a general principle, affects the system but once, and the exceptions to this law are not numerous.

Co-exists.—The varicella may co-exist with the cow-pox, the small-pox, and perhaps with many other morbid poisons.

Modes of Absorption.—The varicella being contagious and infectious, the poison is of necessity absorbed, both by the cutaneous and mucous tissues.

Period of Latency.—The period of latency of the poison, in two cases inoculated by Willan, was thirteen days in the one, and fourteen days in the other. In a third case, inoculated by Mr. Wachsel, the arm began to rise on the third day. The period of latency of the poison in the natural varicella is not determined, but it seems to be a law of eruptive diseases that the period is shorter when the poison is introduced by inoculation than when it is absorbed by the mucous membranes.

Pathology.—The theory of this disease is, that a poison is absorbed and infects the blood, and after a given period of latency gives rise to primary fever, which lasts from twenty-four to seventy-two hours, when the eruption appears and runs a course of eight or ten days. The fever is much mitigated on the appearance of the eruption, and entirely subsides with it.

The law that fever precedes the eruption is so generally received, that no exception is to be found in any writer. The febrile affection is of a mild character, and though for a few hours it may be severe, yet perhaps it never passes into a brown-tongue stage. The eruption has three stages,—that of varus, of vesicle, and of incrustation; and after the fever has lasted from twenty-four to seventy-two hours, a number of red papulæ, or vari, appear, which become vesicular, and perhaps in a few points pustular, on the first day. On the second day the vesicles are *umbilicated*, and filled with a whitish or straw-coloured lymph. On the third and fourth days they attain their greatest magnitude, when the central bride ruptures, and they become *acuminated*, and shortly after they burst and shrivel, except those which contain purulent matter, and have much inflammation around their base. The fifth day they begin to crust, and in four or five days more the crusts fall off, leaving for a time red spots on the skin, generally without, but sometimes with, a "pit" or depression. The "pit" is permanent, and the cicatrix generally whiter than the original tissue, and the patient consequently is marked or scarred.

The eruption is not at first universal over the body, but usually consists of a series of crops, which succeed each other at intervals of 24 hours, and die away in the order of their occurrence. The first crop usually appears on the breast and back, and afterwards on the face and extremities. The number of crops may be limited to two or three, while, in other cases, a new succession will appear every 24 hours for 10 or 12 days.

Symptoms.—Of the varicella there are three kinds, or the varicella lenticularis, the varicella coniformis, and the varicella globosa,—the first being usually termed the swine or hive-pox, and the two latter, chicken-pox. The symptoms of their varieties are similar to each other; their only differences consisting in the size and form of the vesicle, that of the varicella globosa being the largest.

The fever which precedes this eruption is often as severe as that which precedes a mild small-pox or the measles, but it generally, though not constantly, remits on the appearance of the eruption, and does not return as it ripens. Dr. Willan mentions its having been accompanied in some few cases by angina, but how far this is accidental has not been determined.

Diagnosis.—The varicella, of whatever kind, is distinguished from the small-pox by the shortness of the primary fever, by the rapid course of the eruption, and by the greater number of the crops.

Prognosis.—In all cases favourable.

The Treatment consists in abstaining from animal food, in adopting a milk diet, and in paying attention to the bowels.

As this disease is extremely mild, it is better perhaps not to separate the children when it breaks out in a school.

Of Erysipelas.

Erysipelas is an inflammation of the skin, and very commonly of the cellular tissue, and is for the most part preceded or accompanied by fever. The duration of this disease is very various; it may terminate in a few hours, or it may last many weeks.

This disease is treated of by almost every writer, medical or surgical, from the time of Hippocrates; but there is no circumstance connected with its history that would justify particular mention in an elementary treatise. There died 1140 persons in England and Wales of this complaint in 1839.

Remote Cause.—The mystery which hangs over the origin of poisons is seen in a remarkable degree in erysipelas; for this disease is at all times sporadic, sometimes epidemic, and so far it would appear that the poison was derived from, and was constantly present, in the atmosphere. If, however, the doctrine of a spontaneous generation of a poison by the human body be tenable, it is more probably true of erysipelas than of any other disease; for it often happens that the slightest puncture, the opening of a vein, the bite of a leech, or the drawing of a blister, will produce this inflammation; and the disease thus produced has often been found dangerous and contagious, and consequently, if this poison has an atmospheric origin, slight causes often lay the patient under its influence.

Predisposing Causes.—The predisposing causes are age, mechanical or chemical injuries, as blows or burns; also certain articles of diet, as muscles or periwinkles, and many diseases likewise, as dropsy, typhus fever, or other debilitating cause. The effects of age in predisposing to this disease are considerable. New-born children, for instance, are occasionally subject to it, but from that period to adult age it is seldom witnessed.

The period of life most subject to acute attacks is from 20 to 40, and to chronic attacks from 40 to old age. Both sexes suffer in nearly equal proportions.

This disease being once produced is both infectious and contagious.

Infectious.—The spread of erysipelas has been so frequently observed, both in the sick-room and in the wards of hospitals, that no doubt can exist of this disease being infectious, and the following are instances of it. In the year 1760, this disease spread so extensively through the wards of St. Thomas's Hospital, that a report got abroad that the plague was in the hospital. Dr. Baillie has seen it spread in St. George's Hospital, and Dr. Cullen in the hospital at Edinburgh. It has also been found to spread extensively on board ship; and Dr. Wells, Dr. Watson, and others, have given several remarkable instances of its spreading in families.

Infecting Distance.—The infecting distance is considerable. The wards of St. Thomas's Hospital are 28 feet wide, yet the disease has been observed to spread on the admission of a patient labouring under erysipelas from one side of the ward to the other,

Contagious.—Dr. Willan says, if a person be inoculated with the fluid contained in the phlyctenæ or vesicles of a genuine erysipelas, that a red painful diffused swelling and inflammation analogous to erysipelas is produced. The danger, however, attending this experiment has not allowed it to be repeated. Erysipelas also spreads by *fomites.*

Fomites.—In St. Thomas's Hospital a ward has occasionally been obliged to be cleared out to stop the continued spread of erysipelas. In the navy the spread by fomites is so well understood, that it is even debated whether the swabbing the decks or dry-rubbing them is the best mode of disinfecting the ship, and preventing the spread of the disease. This disease also spread extensively, and for a long time, in the Birmingham Hospital, and was at last only got rid of by dry-rubbing, washing the wards appearing to promote its extension.

Susceptibility exhausted.—The patient having passed through this illness, has no security against future attacks of this poison, for many persons suffer repeatedly from erysipelas.

Co-exists.—The contagion of erysipelas is capable of co-existing with many other poisons. We continually observe erysipelas, for instance, co-existing with the primary as well as with the secondary symptoms of syphilis, and also with typhus fever. It was formerly not an unfrequent accompaniment of small-pox.

Modes of Absorption.—It is evident this poison, being both infectious and contagious, must be absorbed both by the mucous and cutaneous tissues, and probably infects the blood.

Period of Latency.—This disease has occasionally followed a few hours after exposure to the infection. Dr. Elliotson thinks five days elapsed in his own case, and Dr. Watson has given three cases in which the interval was a week. An instance occurred at St. Thomas's Hospital, in which a fortnight elapsed after its subsiding in one case and appearing in another in the same ward. It is probable, therefore, the period varies from two to fourteen days.

Pathology.—The theory of this disease is, that a poison is absorbed and infects the blood, and that after a given period of latency it produces generally, but not constantly, the phenomena of fever, which sometimes terminates in inflammation of the membranes of the brain. The great specific actions of the poison, however, are inflammation of the skin and subcutaneous cellular tissue, which runs an indefinite course.

The law that the poison occasions primary fever has many exceptions, especially in traumatic erysipelas from slight wounds, as leech-bites, or trifling punctures, as of a dropsical leg or scrotum. Idiopathic erysipelas is however very constantly preceded by fever, or, according to Frank, 18 times out of 20.

The law that the specific action of the poison is on the skin and cellular tissue has no exception. The affection of the cellular tissue may be trifling, but it is seldom altogether wanting.

The pathological phenomena which result from the action of the poison on the skin, are first, that the cutis is diffusely inflamed, the affected part being either of a bright scarlet or a rose-coloured tint, evanescent on pressure, but returning on that pressure being removed. This inflammation is usually of great extent, occupying very commonly the whole face, head, and neck, or a considerable portion of the trunk, or one or both lower or upper extremities. It runs a course extremely indefinite, as it may subside in a few hours, or continue for many weeks.

This inflammation of the skin may terminate by resolution, by vesication, or by gangrene. When it terminates by resolution, the rose-tint gradually changes to a deeper and more venous hue, and at length fades away, leaving the skin of its natural colour, but with the texture so impaired that desquamation follows. If the inflammation terminates in vesication, the cuticle is raised into a number of vesicles of greater or less size, and sometimes into large bullæ or bladders containing a yellowish transparent serum. The cuticle at length ruptures, the fluid is discharged, and a crust sometimes forms, which, on falling off, leaves the skin underneath either sound or else superficially ulcerated. Should the termination be by gangrene, the skin becomes livid or black, its whole texture more or less disorganized, while the bullæ or phlyctenæ which often form in these cases are filled with a bloody serum. The cutis, when examined after death, whatever may have been the form of the disease, is always found greatly thickened and infiltrated, but the redness, except in cases of gangrene, has entirely disappeared, the action of the capillary system long surviving that of the larger blood-vessels.

It is seldom that erysipelas is limited to a simple affection of the skin, for more commonly at some period of the disease the corresponding portion of the cellular tissue becomes the seat either of serous, adhesive, suppurative, or of gangrenous inflammation. When the termination is by effusion of serum, the quantity of fluid effused is generally so considerable that the head, face, or limb, is greatly and sometimes even hideously swollen; and if the part be now incised, the vessels are seen enlarged and more numerous than usual, and the cellular tissue loaded with serum, sometimes turbid and flaky. The tissue is also more easily torn than usual. This inflammation may terminate by absorption of the serum, but in a few cases ulceration follows, and in a few others gangrene.

Adhesive inflammation, or a deposit of lymph, seldom takes place in erysipelas without its being accompanied by the serous or the suppurative inflammation. When the patient, for example, has died from erysipelas of the head, much loose watery lymph is usually found in the integuments of the scalp or other affected part. The

lymph thus thrown out, however, often becomes organized in this disease, causing a joint to be bound down, and its motions to be impaired, or an eyelid to be either inverted or everted.

Suppurative inflammation is uniformly preceded by serous inflammation, and the result may be the formation of an abscess, or what is much more common, pus may be *infiltrated* through the cellular tissue uncircumscribed by any adhesive inflammation, a circumstance improperly considered by many pathologists as pathognomic of erysipelas. The parts more usually the seat of phlegmonous circumscribed abscess are the eyelids, and the integuments covering the cheek-bones, and the pus in these cases is usually of a laudable and healthy character. In all other parts of the body the abscess is diffuse, and the inflammation being of a low type the pus is poor, and often little more than a fœtid sanies; and should the parts slough, it becomes loaded perhaps with a dirty broken-down cellular tissue, generally mixed with some loose lymph. In some instances the suppurative process extends between the muscles, causing extensive and often irreparable mischief. In the event of this inflammation terminating by gangrene, the integuments of an entire limb are sometimes detached, laying bare the muscles, a large artery, or a bone, involving the aponeuroses and tendons, and sometimes destroying the interior of a joint. Gangrene, however, does not equally take place in all parts, for it is seldom seen on the scalp, the face, or the trunk. It is the extremities, then, and more especially the leg and thigh, and also the labia and scrotum, that more particularly suffer from this affection.

The appearances found within the cranium are similar to those found in typhus fever. In a few instances the mucous membrane of the intestinal canal has been found inflamed or ulcerated, but not so frequently as to be attributable to an action of the poison.

Symptoms.—The symptoms of erysipelas arise out of the fever and local affection, and give rise to three degrees of intensity, or to erysipelas mitior, erysipelas gravior, and to erysipelas gangrenosum; and these may be acute or chronic.

In acute cases of erysipelas, the erysipelatous inflammation is generally preceded or accompanied by fever; and the attack may be sudden, or else ushered in by rigors, irregular flushings, muscular pains, accelerated pulse, white tongue, nausea, vomiting, and deranged bowels. These symptoms, when they do exist, last for some hours, perhaps till the end of the second night or beginning of the third day, when the fever becomes continued, and shortly afterwards the cutaneous inflammation appears, but without any remission of the fever.

The stages of erysipelatous fever are usually but not necessarily three in number. The first stage is marked by a white tongue, by headache, oftentimes by delirium, and by a pulse varying from 90 to 110; and this stage, if the disease be mild, may constitute the whole disease, the tongue not passing into the brown state. More commonly, however, the fever proceeds, and about the fourth, fifth, or sixth day the tongue becomes brown and dry, the temperature falls perhaps to the natural standard, but the pulse rises to 120 to 140; and the active delirium changing to a low muttering with subsultus, marks the formidable second stage of this dangerous disease. This stage is often extremely rapid, sometimes not lasting more than a few hours, or at most three or four days, when the third stage commences; and if the termination be favourable, the tongue begins to clean, the pulse becomes slower, the delirium subsides, and the patient rapidly recovers; or else, on the contrary, if the disease takes an adverse turn, fatal symptoms fast gather around the patient, and the catastrophe is death.

The whole duration of this fever is generally much shorter than that of typhus; so that in idiopathic erysipelas the three stages are often concluded in the space of five, six, or seven days, and it is only in a few cases prolonged to the fourteenth or twenty-first day. If, however, the local inflammation terminates in sloughing or gangrene, the patient may fall into hectic, and the disease may now last for many weeks or even months. When the local inflammation precedes the fever, as in erysipelas from dropsy, the white-tongue stage may be wanting, the tongue becoming brown in a few hours; and under these circumstances, should gangrene follow, the patient is irrecoverably lost.

The *local* symptoms vary according to the part affected, the mode of termination of the inflammation, and also according to the character and duration of the fever.

When erysipelatous inflammation affects the face, it may begin either in the skin, or else in the subjacent cellular tissue. If the cellular tissue be primarily affected, the face at the inflamed part becomes swollen, but the skin suffers no discoloration for some hours, so that it is impossible to distinguish it from an ordinary attack of swelled face. At length, however, the skin inflames, and the part is now red, hot, and painful as well as swollen, and the disease is fully formed.

At the commencement of erysipelas of the face, the attack is usually partial, and perhaps limited to the bridge of the nose, to one ear, to the lower eyelids, or to one cheek; but in severe cases it gradually extends, often involving the whole of the integuments of the face, head, and neck; so that at the end of three or four days those parts present a strangely swollen, disfigured, and even in some instances, hideous appearance, scarcely a feature being discernible. The nostril, moreover, is imperforate from internal swelling, so that the patient is obliged to breathe with his mouth open, while the inflammation may extend to the auditory passage, and render the patient completely deaf.

On the fourth, sixth, eighth, or some later day, the bright-red colour of the skin changes to a deeper hue; the serum effused is absorbed, and desquamation taking place, the skin gradually returns to its natural colour. It is not unusual, however, for abscesses to form, particularly on the eyelids or cheeks, and which being opened quickly, heal, and hardly retard the convalescence of the patient. In some cases the disease becomes *erratic*, and extends over the chest or down the back, and desquamation is seen going on in one part while the erysipelas is spreading in another.

The trunk is occasionally the seat of this disease; and in this case the febrile affection is less violent in the first stage than in inflammation of the face; but in the second stage it is often much longer and of a lower type, so that the whole duration of the disease is increased, and perhaps the termination more constantly fatal. The inflammation more frequently attacks the lower than the upper portion of the trunk, and more frequently the back than the abdomen. It has also a greater tendency to become erratic than similar affections of the face; and when, as it often does, it termi-

nates in effusion of pus among the muscles, the patient seldom recovers.

The extremities are more commonly the seat of erysipelatous inflammation than the trunk, and the lower extremities are more frequently affected than the upper. When these parts are affected, the fever is less severe than in erysipelas of the head; but the local symptoms are generally more formidable, for the degree of heat is greater and the pain so severe, that the weight of a sheet can hardly be borne. The inflammation likewise often involves the lymphatic vessels and glands, which can now be traced by white or red lines for many inches, as from the knee or elbow to the inguinal or axillary glands, which sometimes enlarge and suppurate. If the erysipelatous inflammation ends in suppuration, the abscess is always diffuse, and the swollen limb gives a peculiar sensation to the hand, and which has been compared to what a person feels on passing over a quagmire. The dark, black, discoloured appearances of gangrene are too obvious to render any description of the parts so affected necessary.

Diagnosis.—The diagnosis of erysipelas is in general easy. For a few hours, perhaps, if a joint be attacked, it may be mistaken for acute rheumatism; or if a surface be attacked, it may be confounded for a short time with erythema, but the intumescence and spread of the disease quickly enable us to rectify the error.

Prognosis.—This disease is so influenced by treatment that it is difficult to estimate the proportion of deaths to recoveries. Some practitioners give as a result one death in three; while others affirm it to be only as one in ten, or even a much larger number.

Treatment.—Broussais states, that when he served with the French armies in Italy, he has seen erysipelas, for want of medicine, allowed to run its natural course, and that the result was, it made immensely rapid progress, and ended either in suppuration, in gangrene, or in fatal visceral inflammation. Some mode of treatment is therefore imperatively necessary to control this too often fatal disease, and it is to be regretted that the profession are not as yet unanimous as to the means to be adopted.

Erysipelas is admitted to be a highly inflammatory disease; and in the opinion of one party it is a disease of simple inflammation, and consequently ought, like the other phlegmasiæ, to be treated by general and local bleeding; while on the contrary, the opposite party contend that it is a specific inflammation, and that a long experience has shown that bleeding is often injurious, and that a tonic mode of treatment is much more uniformly successful.

There are very few physicians, from the days of Hippocrates to the present time, who have not bled in erysipelas, and consequently this experiment has been made on a large scale; still many of the warmest advocates of bleeding allow that operation to be occasionally followed by many unpleasant consequences. Mr. Lawrence, for example, speaks of having obtained much success by this treatment; but in seven cases of idiopathic erysipelas which he details, and in which bleeding was adopted, in one he was obliged to have recourse to bark; while in another the disease ran on from April to August. He also gives seven cases of traumatic erysipelas, which he likewise treated by copious general and local bleeding, but with so little success that he was in all of them driven to the unhappy necessity of making his long incisions on account of suppuration taking place.

In France, Dupuytren also adopted a similar treatment, in the belief that erysipelas was a disease of simple inflammation, and that energetic bleeding was necessary to subdue it. He gives five cases; and of these, two died; a third party lost the use of a limb; while in a fourth, the disease, notwithstanding the treatment, continued to spread; and the fifth only appears to have entirely recovered.

The treatment by bleeding, it has been seen, has been often followed by so many unfavourable exceptions, that many physicians, the most intelligent of the profession, affirm that, according to their experience, that practice is not only unfavourable but highly injurious. Andral is reported to have said, "in erysipelas with delirium bleeding pales the skin, but the disease continues; the cellular tissue remains gorged, and death follows. We open the body but find nothing." Cruveilhier says, "*des erysipèles rentrés*" is a consequence of unusual or too abundant bleeding, and he considers the question of bleeding, in this disease, to have been "*depuis longtemps jugée.*" Blache and Chomel likewise say that "experience has proved that general bleeding has no other effect than to blanch the eruption without notably abridging its duration." In this country, Drs. Fordyce, Wells, Pearson, Heberden, and Willan all give their testimony to the frequent ill effects of bleeding in this disease; and, in consequence, they, for the most part, recommend a tonic treatment, or by bark; and many practitioners have gone so far as to affirm that bark is a specific for this formidable disease. There seems no reason, however, for considering bark to be a specific for erysipelas, though a highly useful adjuvant, for it seldom favourably influences the disease till the tongue becomes brown and dry, and the patient consequently reduced to a state of much danger. Indeed, a long experience in the wards of St. Thomas's Hospital has rendered it probable that a treatment by wine is much superior to that by quinine or bark, and greatly so as a general principle to that of bleeding. The mode, then, of treating acute idiopathic erysipelas, whatever be the part affected, and with whatever symptoms accompanied, is to put the patient at once on a milk diet, to open his bowels, and to exhibit 4, 6, or 8 ounces of wine diluted with water, or with sago, or arrow-root, in the 24 hours, according to the severity of the symptoms. This mode of treatment cannot be instituted too soon, and it is seldom necessary to vary it throughout the whole course of the disease; for the delirium, if present, is generally tranquillized, or, if absent, prevented; the tongue, also, more rarely becomes brown, or only continues so for a few hours, while the local disease seldom passes into suppuration or gangrene. In a word, all the symptoms are mitigated and the course of the disease shortened. In a very few cases, however, something more is necessary to be done, and then quinine, gr. j. to iij., may be given with great advantage in very severe cases every four or six hours; and again, a few apparently hopeless cases have been saved by a drachm of quina in half-a-pint of barley water thrown up as an enema every night. In very mild cases, as in erysipelas after leech-bites, the disease may be in a great measure left to itself, or be treated by some slight purgative, to which it readily yields. Many other methods of treatment have been recommended, as by tartarized antimony, purging, &c.; but these modes do not appear to have been by any means generally successful.

The general treatment is, by most practitioners, accom-

Elementary Principles of Medicine.

panied by some *local* treatment, as blisters, poultices, fomentations, cold lotions, the application of mercurial ointment, drawing a line of limitation with lunar caustic, punctures with the lancet, the application of leeches, and large incisions through the integuments and down to the fascia. The value, however, of any or of all of these auxiliaries in idiopathic erysipelas is extremely doubtful; for even the most simple, and apparently the most applicable, or cold lotions, are supposed by Cullen and many other close observers to favour the formation of pus.

The treatment of the part, after suppuration has taken place, is a free opening, poultices, and the ordinary rules of surgical treatment.

Dietetic and preventative Treatment.— It is essentially necessary that the patient should be restricted to a farinaceous diet and to slops till he is decidedly convalescent. The preventative measures are cleanliness, separation, and ventilation; and the attendants should be cautioned of the great probability of their contracting this disease in the event of any contravention of these rules.

Of Hooping-Cough.—*Pertussis.*

Hooping-cough is a disease in which the poison produces a slight catarrhal fever followed by a peculiar paroxysmal cough.

The origin of hooping-cough appears to be of no distant date, Sprengel not having been able to trace it beyond 1510, when it was endemic in Paris; but its epidemic character was not determined till 1580, when it destroyed a prodigious number of children throughout Europe. This disease prevails now all over the world, or from the North Pole to New Holland. It is of much fatality, 8165 persons having died of this disease in 1839 in England and Wales. This poison, like that of the exanthemata, has the property of exhausting the susceptibility of the patient to its future actions on the first attack.

Remote Cause.—The fact of the susceptibility to this disease being exhausted on the first attack is a sufficient proof of the hooping-cough being caused by a particular agent; but in what manner this agent is generated is not determined. This disease is always sporadic, sometimes epidemic. The reports of the registrar-general for the year 1839 show that 1674 died in the winter quarter, 1208 in the spring quarter, 644 in the summer quarter, and 787 in the autumnal quarter; but the returns at present are too few to allow us to determine whether this ratio as to season be constant. The poison has probably a telluric origin.

Predisposing Causes. — The predisposition to this disease is so strong that few persons pass the period of childhood without suffering from it; but it may occur at any subsequent age. The early age at which the large majority of patients pass through the disease is, however, a sufficient reason for our very slight acquaintance with the predisposing causes.

When the hooping-cough is once excited, the patient's person secretes a poison which is both infectious and contagious.

Infectious.—The public are unanimously of opinion that hooping-cough is infectious, and no parent will permit his yet unaffected child to mingle with such as may be labouring under the disease. The profession, also, are, with a few exceptions, of the same opinion. It is supposed to have been first introduced into Van Diemen's land by a female prisoner, and subsequently to have spread both to the settlers and natives.

The infecting *distance* of this poison must be considerable, from the utter impossibility of isolating the little patient at home, or of preventing the spread of the disease in schools and asylums

Contagious. — Since no cutaneous eruption accompanies this affection, the fact of its contagious nature cannot, as in the exanthemata, be strictly demonstrated. The communication, however, of this disease by *fomites* is an *a fortiori* proof this law.

Fomites.—Rosen conceives that, without being aware of it, he has often carried the disease from house to house. Frank also says it is often propagated from patient to patient, from house to house, and from village to village. Lombard says, that in Geneva, he has often traced the first cases occurring in that city to a neighbouring town, or to a sick child from the country. It was some years ago introduced into St. Helena, where it proved greatly fatal, the captain of a ship having some children labouring under hooping-cough on board having been allowed to send their dirty linen on shore to be washed.

Susceptibility exhausted.—The hooping-cough, as a general principle, affects the same person but once, and the exceptions to it are exceedingly few. Blache, however, gives a remarkable instance of a grandfather and grandmother catching it a second time from their grandchild, and all of them labouring under the disease together.

Co-exists.—The poison of the hooping-cough may co-exist with many other poisons, and in this case they often greatly influence each other's actions. The small-pox and hooping-cough have often co-existed; and a very common and fatal combination is measles and hooping-cough. Hooping-cough and cow-pox is not unfrequent. Indeed, the lower classes look upon vaccination as, in many instances, a cure for the hooping-cough.

Modes of Absorption.—If the law be established, that the hooping-cough is both contagious and infectious, it follows that the poison must be absorbed both by the mucous membranes and by the cutaneous tissue.

Period of Latency.—Our knowledge of this fact is at present extremely imperfect, but the more received opinion is, that the period of latency is about five or six days.

Pathology.—The theory of this disease is, that the poison produces slight primary fever, which for the most part subsides on the specific or secondary actions being set up, which are disordered actions of the pulmonary and gastric branches of the eighth pair, causing the peculiar cough and vomiting. It seems probable, also, that this poison has a tertiary action on the mucous membrane of the intestinal canal, and also on the substance and membranes of the brain.

The hooping-cough, in its earliest stage, is merely a disease of function, and often continues so throughout its whole course; for many cases have been examined in which no trace of inflammation, or other disease, has been discovered in any part of the body. If, however, the disease be of greater intensity, it very commonly produces structural disease of the lungs, stomach, intestinal canal, or of the membranes of the brain.

Rostan says, "I have examined some children that have died of this disease with great care, and I have constantly found alteration of structure of the respiratory organs. The most common of these alterations is

peripneumony, either single or double, with pleurisy and catarrhal inflammation of the bronchial membrane." These facts being corroborated by every writer, there can be no question but that this poison acts on the pulmonary branch of the eighth pair.

Dr. Watt, on examining the body of his son, Robert Watt, found, "on laying open the stomach, the internal surface had numerous red streaks, the marks of inflammation. There was also an universal crust of exudation, and much of it was collected on the upper surface, and not owing to the position of the viscus." In two cases that died at the London Foundling Hospital, in addition to the usual inflammatory appearances of the lungs, the mucous membranes of the stomach were in each case singularly red and injected. Both stomachs, also, were filled with the glairy matter vomited up in the disease. This poison consequently acts on the gastric portion of the eighth pair.

With respect to the tertiary actions of the poison, we occasionally, on opening patients that have died of hooping-cough, find the glandulæ aggregatæ vel segregatæ considerably enlarged, a circumstance which can hardly be considered accidental, when Blache states it existed in five cases out of nine that he examined. It has been a question whether the cerebral symptoms were the result of the violence of the cough, or of a tertiary action of the poison, but the latter theory seems the most probable. The patient sometimes has died with formidable convulsions, and yet no alteration of texture been discoverable. When, however, lesions of structure do exist, the membranes are injected, and serum effused into their cavity, and into the lateral ventricles. The substance of the brain, also, has more puncta cruenta than usual, and some very limited portions are said to have been found softened.

Symptoms.—The symptoms of hooping-cough arise out of the previous fever, the cough, vomiting, and also the different inflammations with which it may be accompanied.

The law that fever precedes the cough, though generally true, has many exceptions; for the paroxysms of cough are often established, and more particularly in summer, without being preceded by any febrile phenomena. The severest attack, indeed, seldom confines the patient to his bed, so that it rarely exceeds that accompanying ordinary catarrh. Hooping-cough varies greatly in intensity, and is, therefore, divided into

Pertussis mitior and into *Pertussis gravior*.

Most authors divide the group of symptoms of hooping-cough into three stages. The first stage comprehends the period from the first symptoms of illness until the hoop confirms the nature of the cough. The second stage commences as soon as the nature of the cough is determined, till the violence of the cough and the danger of the inflammation be past. The third stage is the convalescence of the patient, until the final and happy termination of the disease, or else the occurrence of those symptoms which destroy the little sufferer.

First Stage.—The early symptoms of the hooping-cough, and more especially in the spring and fall, are those of a common cold—as hoarseness, sneezing, a watery discharge from the eyes and nose, much oppression of the chest, a short dry cough, and such fever and other derangement as usually attend an ordinary cold. This stage usually lasts from one to eight days, but Willan has estimated it from one to two or three weeks, and Lombard has extended it to six or eight weeks.

Second Stage.—It is not until the fever remits, and is about to pass away, that the cough, which had distressed the patient, is followed by the characteristic hoop. On the occurrence, however, of this symptom, the disease is fully formed, and now consists of a series of fits or paroxysms of severe coughing, which occur at uncertain periods, while, during the interval, the little patient often enjoys his usual health, recovers all his gaiety, returns to his play, and relishes his food with good appetite. A paroxysm, or fit of the hooping-cough, is as follows:—

The approach of the fit is often denoted by an unpleasant titillation of the glottis, by a sharp pain in the chest, or else by a spasmodic contraction of the diaphragm. As soon as the child is thus warned, he instinctively runs to his nurse, and either grasps her arms, or lays hold of her chair, to support himself during the paroxysm, which in a few minutes or a few seconds is about to follow. In severe cases the cough is quite convulsive, and so rapid is the action of the diaphragm, that the air is almost instantly expelled from the lungs, and the patient, half suffocated, turns black in the face, and frequently passes his urine. At length the crisis approaches, the diaphragm relaxes, and a violent inspiration follows, accompanied by the characteristic hoop. This sound perhaps remits, but after a few seconds returns; and thus convulsive inspirations and expirations continue, till the patient is at length relieved by a copious expectoration, or else by vomiting. The matters expectorated from the lungs are frequently thick, viscid, and muciform. When vomited from the stomach, the patient throws up a glairy fluid of much tenacity, semi-transparent, and frequently amounting to the greater part of a pint; and should he have recently eaten, the food often returns with it. It frequently happens, however, that the stomach, by a sort of election, retains the food, and rejects the offending matter. If the fit be violent, the fluid rushes not only from the mouth, but also from the nostrils; and in some instances is mixed with blood, for blood occasionally bursts in considerable quantities from the congested vessels of the mouth, the nostrils, the ears, the eyes, and in some instances also from the lower parts of the body.

If the stethescope be applied to the chest previous to the fit, we sometimes detect the mucous rhoncus, common to catarrh; yet in most cases the respiration is natural. During the act of coughing, the respiration is completely suspended, and not sensible to the ear in any part of the chest. On the hoop, however, taking place, the air is heard to rush with remarkable violence into the trachea; but at this point it stops for one or more seconds till the bronchial tubes relax, and the air is then admitted into the lungs.

The fit having subsided, the eyes, which had nearly started from their orbits, resume their natural position, but are inundated with tears, or else the conjunctiva is more or less gorged with blood: the natural expression and appearance of the countenance returns, and in a few minutes, in favourable cases, the good spirits of the little patient are renewed, and he eats with appetite. On the contrary, in severe or unfavourable cases, long-continued exhaustion, headache, and some fever, are the preludes to convulsions, inflammation, or the other severest forms of the disease.

The paroxysm varies greatly in frequency and severity, but in general its frequency is as its severity. In ordinary cases it returns every two hours, but in

severer cases, and especially during the second and third week, it returns every half or every quarter of an hour, or even oftener. This disease commonly reaches its acmé at the end of the third, fourth, or fifth week; after which the paroxysms diminish in frequency, the intervals are prolonged, and the patient is to a certain degree convalescent. The duration of this second stage is from two to six or eight weeks.

Third Stage.—The third stage commences with the convalescence of the patient, when the paroxysms become milder, the intervals longer, the expectoration more natural and less in quantity, and the vomiting ceases, so that the general health of the patient is much improved. The duration of this stage, however, is often long and variable, and the cough may still harass the patient for many weeks, or even many months. It is to this stage that the term chronic is usually applied.

The whole duration of the stages of hooping-cough are liable to greater variations than in almost any other disease; for this complaint may terminate in two or three days, and after a very few paroxysms, or it may last two, three, or four months, or even more than a year. Lombard has given a calculation of the number of paroxysms of an ordinary attack, and he estimates them at three hundred and eighty-three day paroxysms, and four hundred and fourteen night paroxysms.

Such is the progress of an ordinary case of pertussis mitior, or as long as the disease is limited to mere neuroses of the parts affected; but in particular seasons, and in particular persons, many accidents may arise to complicate the symptoms, and to increase the danger, as inflammation of some of the tissues of the lungs, of the mucous membrane of the stomach or intestines, or of the serous membranes of the brain.

Inflammation of the mucous membrane of the bronchia is the most usual complication of the hooping-cough. The form of inflammation may be that in which the secretions are in defect, so that the mucus is not only greatly diminished in quantity, but is thick and viscid, teazing the patient with fruitless efforts to free it from the lung, and thus causing a frequent recurrence of the paroxysm. In other cases it may assume the form of purulent inflammation, the pus secreted being formed into sputa, and moderate in quantity or else it may be thrown up pure, as from an abscess, and so enormous in quantity as to amount to one or two pints in the twenty-four hours. The inflammation of the bronchial membrane may spread to the substance of the lungs, when the danger, as well as the symptoms of some of the various forms of pneumonia will be added to the disease; but the most formidable accident is when the pleura is inflamed, for then the patient's sufferings during the paroxysm are fearfully increased, from the agonizing pain inflicted during the paroxysm of the cough.

The mucous membrane of the stomach and intestines is also often the seat of inflammation; and this is denoted by pain in the epigastrium, and by the suppression of the glairy fluid thrown up by vomiting, so that on the termination of the fit the patient often lies in a state of complete exhaustion, unable to discharge anything either from the stomach or lungs, or even to hoop, and he is now said to labour under the *dumb kink.*

In mild cases the bowels are little affected in this disease, except that the patient sometimes passes his fæces during the paroxysm. In severe forms the stools are often either black and offensive, or else consist of a colourless mucus, the latter evidently depending on an inflamed state of the mucous follicles.

Headache is a symptom which usually attends the catarrhal stage, but generally ceases when the fever subsides. In some instances it continues throughout the disease, and is not unfrequently the forerunner of fatal convulsions, or epilepsy, or else of inflammation of the membranes of the brain terminating in delirium, coma, hydrocephalus, and death.

Diagnosis.—It is impossible to determine whether the febricula of the first stage is the result of simple catarrh, or will, on its subsiding, prove to be hooping-cough. As soon, however, as the cough has been followed for two or three paroxysms by the hoop, the diagnosis is perfect, no other disease being accompanied by this symptom.

Prognosis.—The proportionate number of deaths to recoveries, in hooping-cough, is not determined, but it greatly varies in different years; for in one year, says Frank, hardly a death will occur from this cause in a large city, while in another year many children will fall. In general, however, pertussis mitior is rarely fatal, while pertussis gravior is very commonly so. Lombard thinks station in society greatly affects the mortality; for he says, and may fairly assert, that of ten fatal cases nine belong to the poorer classes. The reports of the registrar-general show that the mortality is greater from this disease in towns than in the country, being in the metropolis, in 1838, ·111 per cent., while in England and Wales it was only ·061. In the year 1839 also, it was for the metropolis ·061 per cent., while for England and Wales it was ·053. Lombard gives the ages of 40 fatal cases as follows:—

From birth	to	6	months	6
„ 6	to	12	months	7
„ 1	to	2	years	10
„ 2	to	3	ditto	6
„ 3	to	4	ditto	7
„ 4	to	5	ditto	2
„ 5	to	6	ditto	2
„ above		6	ditto	0
				40

Treatment.—The stage of invasion is seldom marked by symptoms of greater severity than those of common catarrh, and consequently, except putting the patient on a low diet, and attending to his bowels, there is little occasion for medicine, especially as the diagnosis can hardly be said to be yet complete.

The hoop having confirmed the nature of the disease, and the second stage established, the disease will now run its course, and two indications of treatment present themselves. The first is to prevent, if possible, convulsions, or any attack of inflammation, either of the lungs, the stomach, or of the membranes of the brain. The second indication is, after the period of danger is past, to prescribe such medicines as may interrupt the course, and anticipate the time of the spontaneous cessation of the disease.

The best mode of obviating the danger of cerebral irritation, or of inflammation of any of the organs that have been mentioned, is to mitigate and control as far as possible, the frequency of the paroxysms, to check those secretions which are in excess, and to excite those which are in defect, and these objects are best obtained by mild opiates, combined with gentle purgatives or laxatives.

The choice of the opiate has been considered a matter

of much importance. The continental physicians have bestowed much praise on belladonna, others on hemlock, others on henbane, while others have contented themselves with opium. It must be admitted, however, that neither of these narcotics possess any specific property in controlling this disease, so that the selection of the particular one must be left to the discretion of the practitioner. But supposing the patient to be a child, as the head is especially the organ to be protected, the mildest, as hyoscyamus, or the syrup of poppies, are the safest and best. Should, however, belladonna be selected, if the child be under 4 years of age, the dose ought not to exceed one-eighth of a grain; or if hyoscyamus, half a grain to a grain, every six or eight hours; while if it be the syrup of poppies, this medicine should be given in such fractional doses of a drachm as are suited to its age.

But an opiate, in the early stage of the disease, ought not to be administered alone, and some purgative or laxative ought, as a general rule, in all cases, to be combined with it. The selection of the particular medicine is perhaps unimportant, and any vegetable or saline purgative will perhaps answer equally well, as the confectio sennæ, rhubarb, or castor oil, or manna. The neutral salts, however, sit easiest on the stomach, and, as the medicine must be continued, are the most agreeable to the patient; and the best combination for children, perhaps, is syrupi papaveris c. magnesiæ sulph. āā ʒ ſs. to ʒ j. ex. mist. camphoræ 6^{tis} vel 8^{vis} horis. This prescription generally puts this disease in a safe train, and is, in many instances, all that is necessary to insure its termination in a moderate time.

Towards the close of the second stage the symptoms may, in a few instances, become unfavourable, and cerebral irritation, with convulsions, or inflammation of the membranes of the brain, of its substance, or of the tissues of the lung, or of the alimentary canal, may complicate the disease, and now the treatment of the case is always exceedingly difficult, and frequently unsuccessful.

If the convulsions should come on suddenly, and without headache, or other symptom of inflammatory action, small doses of any opiate, and mustard poultices to the feet, often relieve the patient; but should the convulsions still continue, an assafœtida injection may be thrown up. It often happens that the convulsions are combined with a suppression of the vomiting, and of the usual glairy discharge; and in these cases leeches, followed by a large linseed poultice, should be applied to the epigastrium. If the disease should proceed, and headache or other symptom show an affection of the membranes of the brain, leeches should be applied to the temples and cold to the head.

When the poison excites inflammation of the tissues or substance of the lungs, bleeding to a limited amount is imperatively required; but we should be satisfied with such mitigation of the symptoms as may obviate immediate danger, and even that is not always obtained, since the affection is not to be subdued by bleeding, as in simple inflammation, for, being dependent on the action of a morbid poison, it will run a given course. Blache, for instance, bled in nine cases, either with the lancet, by leeches, or by cupping, and in one case no less than five times; yet, he adds, with a desolating want of success, and eight out of the nine cases terminated fatally. This result makes him add an axiom, in which every practitioner will agree, that there is in severe hooping-cough, as in typhus, cholera, and many other affections, an unknown element which controls all these intercurrent inflammations.

If the intestinal canal be affected, some sharp purgative, combined perhaps with calomel, may be necessary, to act on the bowels and free them from their contents; and, if the stools be white and muciform, and the patient not relieved, an enlarged state of the follicles may be suspected, and consequently a large linseed poultice should cover the abdomen for some hours, preceded, perhaps, by an enema of syrup of poppies and barley-water, and which afterwards should be thrown up night and morning. Many other modes of treatment have been recommended for the cure of hooping-cough, and more especially a treatment by emetics repeated every second day; but, as the emetic is admitted to have no specific property, it seems difficult to understand how its action can be salutary, especially as in most instances the patient throws up, in a greater or less degree, after each paroxysm of coughing.

The disease having passed into the third stage, and the inflammation or other threatening symptom, if any has existed, having subsided, it is desirable to attempt to abridge the duration of the cough, which often extends to a most distressing length: and for this purpose tonics, anti-spasmodics, and other remedies, either external or internal, have been recommended.

The more stimulant anti-spasmodics, as assafœtida, musk, castor, oil of amber, cantharides, and camphor, are the remedies which have obtained the most suffrages in the cure of this stage of the hooping-cough. But the two first are most esteemed, and some persons even consider assafœtida to be a specific, not only in this, but in every other stage of the disease. Cullen, however, preferred cinchona to assafœtida, and considered it "the most certain means of curing the disease." Many other remedies have been mentioned, as alum, hydrocyanic acid, oxide of zinc, arsenic, and many preparations of iron, and all of these remedies have perhaps been found to a certain extent useful; but in estimating the results of remedies, however, we should be careful not to mistake recovery for cure.

When internal remedies have failed to make any impression on the hooping-cough, the cure is often attempted by means of local treatment, or by derivatives. The early physicians applied actual cautery to the nape of the neck; the modern ones, blisters to the spine, or have directed the back to be rubbed with the unguentum antimonii cum potassio tartarizati, or with some liniment or embrocation, as the linimentum camphoræ, linimentum ammoniæ, or with assafœtida, oil of amber, oil of turpentine, or the tincture of cantharides. The general opinion, however, is, that these do little good unless they contain some opiate, whose absorption they facilitate. Nevertheless, "*Ne crede tali auxilio*" is a truth, however, too often inculcated as the result of their employment. Foot baths and the warm bath have also been used, and often with much efficacy.

When ordinary remedies have failed a change of air is a resource of great value, and was first mentioned by Dr. Forbes, in his thesis *De Tussi Convulsivi*, in 1754; and since that period it has been recommended in dangerous cases by most physicians, with that praise it so eminently deserves. It is determined that a change from the bad air of a town to the purer air of the country is at all times of great benefit; but Lombard contends that he has found a change from the country to

the town to be beneficial, and that the patient is benefited even by a removal of so short a distance as half a mile. Indeed, it is impossible to witness more striking instances of the advantages of treatment than we occasionally observe in patients when removed from London to the environs, for in a few hours they often recover from an apparently hopeless state.

Dietetic and General Treatment.—The patient should not be allowed animal food from the commencement almost to the termination of the disease. It is desirable also that the temperature of his apartment should be regulated, and that he should not be exposed to any considerable or sudden change from heat to cold. In mild weather also, if no local symptom forbids, he should be permitted to take exercise in the open air. He should likewise be recommended to wear flannel.

There are no known means of prevention, except an entire removal from every source of contagion.

Of the Cow-Pox—*Vaccinia.*

The cow-pox is a simply contagious disease, the poison producing a single vesicle at each point of puncture. No death from this cause is recorded in either of the reports of the registrar-general.

This poison is the only beneficent agent known in the whole range of morbid poisons; is immediately derived from the cow; and has the singular property of destroying the susceptibility of the human frame to the small-pox, the most virulent contagion we suffer from. Our knowledge of the anti-variolous properties of this poison is due unquestionably to Dr. Jenner, who introduced it into medicine in the year 1798. The necessity for such a remedy arose out of the circumstance, that notwithstanding the general safety of the patient by inoculation, still the time and expense necessary to enable him to undergo that operation were so considerable that a large portion of the population were altogether unprotected. The practice of inoculation consequently was only a means of more widely extending the disease; and it was calculated, from data submitted to a committee of the House of Commons, that for the fifty-five years preceding the introduction of inoculation the proportionate mortality from small-pox was as 72 in 1000, while in the last thirty years of the past century it arose to 95 in 1000. Inoculation consequently was a protection to the rich, but it was destruction to the poor, and hence the necessity of this antidote, of which Dr. Jenner so ably and so successfully availed himself.

Remote Cause.—The remote cause of this disease in the cow is probably a poison existing in the atmosphere, but whence derived is quite unknown. The disease, however, for the most part prevails epidemically, and so irregularly, that Talleyrand wrote in 1831 to the French government, desirous of obtaining vaccine matter from a new source, that, after the fullest inquiry, the cow-pox had not prevailed among the cows in this country for more than twenty years. In France it had not been met with up to that time; but in the year 1836, by an inexplicable *bizarrerie*, it broke out in three separate districts in that country, or at Passy, at Amiens, and at Rambouillet.

It is singular, looking to the deep interest connected with the subject, that we are still unacquainted with the exact nature of the vaccine disease as it occurs in the cow, for Dr. Jenner has left us no drawing, and only a very imperfect description of the eruption from which he vaccinated. The difficulties which surround this question will be seen when it is stated that Dr. Heim contends that the cow is subject to no less than eight distinct forms of cow-pox, five of which are communicable to man. Indeed there is no sort of agreement among authors in their description of the cow-pox in the cow: for some describe it as a local disease of the teat, and void of fever; others, as a local disease with fever. Everybody describes the pock as multiplex, and Jenner is supposed to have obtained his first lymph from an epizootic in which the eruption extended from the extremity of the tail to the base of the horn. The last, and perhaps the best, account of the cow-pox in the cow is that of Mr. Ceely, who observed the disease recently in Buckinghamshire, and who has published a description of it, with drawings, in his *Variolæ Vaccinæ*, and has thus laid the foundation for more accurate observation on this interesting subject.

The poison derived from the cow is capable of producing the cow-pox in many animals, as the dog, the goat, the ass, the sheep, and perhaps the horse. Its most important transmission, however, is to man; and matter taken from the cow produces in the human subject the peculiar disease termed the cow-pox; but supposing the pustule to be multiplex in the cow, the disease is so modified that only one pustule, as a general rule, results at each point of puncture in man. Matter taken from the human subject is said, by retro-inoculation, to produce the vaccine disease in the cow; but now, strange to say, if the original disease has been correctly observed, it gives one pustule at each point of puncture, and no more. The laws of the cow-pox virus, when introduced into the human subject, are as follows:—

Predisposing Causes.—As a general principle, to which there are few exceptions, all ages and both sexes are equally liable to this affection. The adult, however, is less susceptible of this poison than the child, and often requires to be vaccinated two or three times before the disease is produced. As vaccination is practised merely as a preventative of the small-pox, it may be necessary to state that, of 8714 deaths from small-pox in 1839, 2235 took place in children under one year old. It will be plain, therefore, that the earlier the little patient can be vaccinated consistent with its health the better.

Contagious.—The contagious nature of this disease is the basis of its use in medicine; and the vaccine poison is found intimately combined with the lymph, the pus, or the crust of the vaccine vesicle. It is most energetic, however, in the lymph; less so when combined with the pus; and most feeble of all in the crust; so much so that Bousquet thinks if the latter be formed on a pustule in any way broken or interfered with, it is entirely useless and inert. An analysis of vaccine lymph has given nothing but water, albumen, and some rudimentary crystals common to all serous fluids; the specific agent escaping detection. The lymph can be preserved in an active state at an ordinary temperature between two plates of glass for a considerable time; but if heated to 120°, or if frozen, it loses the power of communicating the disease.

Fomites.—The fact of vaccination is a sufficient proof of this law.

Susceptibility exhausted.—As a general law the vaccine disease affects the individual but once during life. The more remarkable circumstance, however, is that the vaccine poison not only protects the constitution against itself, but also against the small-pox, and reci-

procally the small-pox poison protects the constitution not only against itself, but also against the cow-pox virus. It is upon the presumption that this rule is true that the cow-pox has been introduced into medicine as a preservative remedy against the small-pox. On its first introduction the law was supposed to be universal, but each year's experience has shown numbers of persons susceptible of a modified small-pox, or other more severe form of that disease, after vaccination. The consideration, therefore, of the proportionate number of exceptions to the alleged law is one of the most important questions connected with vaccination, and must determine the actual value of this great discovery.

Dr. Jenner ever entertained the opinion that the vaccine and small-pox virus were essentially the same; he inferred, therefore, that as the patient was occasionally attacked a second time with small-pox, so that vaccination would fail in protecting the system from small-pox in an equal number of instances, or in about one in one hundred. The number of cases of failure, however, are unhappily greatly beyond this proportion, for Bousquet thinks that in the epidemic in Marseilles, one in fifteen of the persons vaccinated took the small-pox; and it results from the best data we at present possess, that in about one person in twenty vaccination loses its protecting influence altogether, or else ceases to guard the constitution beyond a period varying, perhaps, from two to ten years, when the party again acquires a susceptibility to an attack of small-pox; an attack, however, so modified, that the proportionate mortality from small-pox after vaccination is only seven per cent., while the rate of mortality from the natural small-pox, the party not having been vaccinated, is no less than thirty-six per cent., or five times greater.

It is certain, also, that the constitution of a vaccinated person does, in a given number of cases, acquire a fresh susceptibility to the vaccine virus, and sometimes so rapidly that, according to Rouch, modified vesicles may be obtained at a very short period after vaccination. These circumstances may appear to diminish the great value of vaccination; but in estimating the actual result of this practice to the community, we find that nineteen twentieths of the population are permanently protected from the small-pox. Again, if we suppose the calculation to be correct that 40,000 persons died in England and Wales from small-pox in 1800, when the population, according to Mr. Finlaison, was only 9,187,186, the total mortality, taking the estimated population in 1838 at 15,324,720 persons, should in the present day be at least 70,000; but the numbers that died from that disease in 1839 were only 9,131, showing a diminution of mortality from this cause of more than six-sevenths in England and Wales. In short, the reasons for preferring vaccination to inoculation is the annual preservation of more than 60,000 lives.

Co-exists.—The vaccine virus is capable of co-existing with many other poisons, as with that of syphilis, of scarlatina, of measles, or of the hooping-cough. But although cow-pox often exists contemporaneously with those diseases, yet we constantly find the one modifying or suspending the course of the other. Of all the complications of the cow-pox with other morbid poisons, that with the small-pox is fraught with the greatest interest, and we find these two diseases co-existing, preceding, and following each other. If the poison of the cow-pox and of the small-pox be separately inserted in different places, for instance, in the same person and at the *same time*, or within *a week* of each other, both diseases form, co-exist, and each pursues its respective course. The lymph also from the vaccine vesicle will produce the vaccine disease, while that from the variolous pustule will produce the small-pox. Again, if the two punctures be near each other, one common areola will surround both punctures.

When a person has been inoculated with a *mixture* of the variolous and vaccine poisons, Adams states only one will take effect. This effect, however, is not uniform; for Bousquet inoculated three children with a mixture of the two poisons; two had the cow-pox only, but in the third the cow-pox preceded, continued its usual course till about the eighth day of the disease, when a slight eruption of the small-pox appeared.

If the patient be exposed to a variolated atmosphere at the time he is vaccinated, both diseases will probably result. If vaccine lymph be inserted four days after exposure to the infection of a variolated atmosphere, the two diseases may co-exist, or the one may precede the other. An example of this latter occurred a short time ago in St. Thomas's Hospital; a child that had been exposed to variolous infection for four or five days, was vaccinated, but the vesicle did not rise; a modified small-pox, or variolæ verrucosæ, appeared, and ran its usual course. This disease terminated, the vaccine puncture began to inflame, a vesicle formed, which, though small, ran its course, and had all the usual characters.

"When the small-pox and vaccine diseases have been inoculated about the same time," says Willan, "the eruptions in all the cases I saw were of the species vulgarly called the horn-pock, being hard, semi-transparent, and, though of long duration, did not maturate." This statement, as a general principle, is correct, but there are exceptions to it; Bousquet has given no less than sixteen cases in which the cow-pox and small-pox co-existed, and yet all the patients perished.

Variolous matter, inserted on the ninth day after vaccination, appears to have its actions wholly superseded. Bousquet, however, affirms that this protecting influence is imparted as early as the fifth day.

Modes of Absorption.—Vaccination shows that this poison is absorbed by the cutaneous tissue. One puncture is followed by one vesicle, which, when normal, is sufficient to give the fullest protection to the constitution; it is usual, however, to make three punctures on each arm, for the purpose of insuring a supply of lymph. The experiments of Staed show that the poison, after vaccination, is rapidly taken up, and the constitution immediately infected; for in no instance has he been able to prevent the disease, although he has, immediately after the puncture, washed that part with water, or a solution of ammonia, or of the chloride of soda. Bousquet has also attempted to prevent the formation of the vesicle by applying the cupping glass instantly over the punctured part, but although he has kept it on for fifteen, twenty, and even thirty minutes, till phlyctenæ have formed, and blood flowed in abundance, still in no instance has he been able to retard the occurrence of the disease.

Mr. Ceely says, that he has produced vaccine vesicles in young children without puncturing the skin, or merely by keeping lymph in contact with it, and excluding the air by a coating of blood.

Period of Latency.—The usual period of latency is

two, sometimes three days; but when the system is under the action of other poisons, the period is often prolonged, and sometimes even three weeks have elapsed from the time of the puncture till the appearance of the vesicle.

Pathology.—The theory of this disease is—the vaccine virus is absorbed, probably infects the blood, lies latent in it a few hours, and then produces its specific action, or a pustule at each point of insertion.

The vaccine pustule runs a given course of varus and of vesicle, terminating by a concretion which forms the crust. The stage of varus lasts but one day. The vesicular stage is four days *umbilicated* and three *acuminated.* The process of incrustation is also three days, and that of detaching the crust three days more; so that, allowing three days for incubation, the whole duration of the disease from the time of puncture to the detaching of the crust is from fourteen to seventeen days. A slight fever usually occurs about the eighth day, and lasts about three days, and occasionally the whole course of the disease is accompanied by a slight fever.

The first day after vaccination we observe nothing but the redness, which is inseparable from every puncture. On the following day it is impossible to determine whether the vaccination has taken place. On the third day, however, sometimes a little earlier, and sometimes a little later, the punctured part is seen to be inflamed, and the varus of the future pustule is formed, and sufficiently elevated to give a sensation of hardness. On the fourth day the varus has considerably enlarged, and on the fifth a vesicle has formed on its apex, and lymph, in some instances, may now be collected from it. This vesicle is yet depressed at its centre, or *umbilicated.* Usually about the eighth day from the time of vaccination, or on the fourth or fifth from the appearance of the varus, the vesicle has attained its greatest size, and is from two to three lines in diameter. It is still umbilicated, its cuticle white and opaque, but a brown spot has appeared in the centre, which shows that the cellular bride which ties it down is about to rupture.

On the eighth day from the time of the puncture, a bright red areola encircles the base of the pustule; an appearance which led Jenner figuratively but happily to remark, that it was now "the pearl upon the rose;" between the eighth and eleventh day the cellular bride ruptures, and the vesicle fills or becomes *acuminated.* At this period the red areola enlarges, and is of a deeper red, while a slight fever, termed the "fever of vaccination," comes on, and lasts from three to four days. About the eleventh day the fever subsides, and between the eleventh and fourteenth days the pustule ruptures, and secretes a fluid which forms a crust. The inflammatory areola has already began to abate, and generally before the seventeenth day the crust falls off, leaving the usual large round cicatrix.

The vaccine cicatrix is round, deep, radiated, and puckered, and is more marked in proportion as it is more recent, but is never entirely effaced by time. Considered anatomically, the vaccine pustule has been compared to a spice-box, being divided into a number of cells, separated from each other by a thin cellular tissue, each filled with a clear diaphanous fluid. These cells do not communicate together, but radiate from the centre to the circumference, the centre being bound down by cellular tissue, giving the umbilicated character to the pustule. This is the state of parts from the sixth to the ninth day; but it does not last, for the lymph now becomes turbid, is mingled with pus, the central bride is broken, the cells communicate, and the pustule rises, is acuminated, and ruptures.

Among the variations in the course of the pustule, Bousquet mentions, that he has several times seen—"plusieurs fois"—such differences in the development of the pustules, that some had run their course while others were only commencing it. M. Fribault has witnessed a fact still more extraordinary, or a pustule which had completed its course beginning *de novo,* and running through it a second time. A still more singular anomaly has also been witnessed, and more at variance with the usual laws of the vaccine virus, or a general cow-pox eruption. Bousquet gives a case in which the supernumerary pustules were so many, that he doubts whether the distinct small-pox ever presented a larger number. A similar case also occurred on the re-vaccination of the Prussian army. A case of this kind also occurred in the child of a gun-smith, in Oxford-street, and which at length died, exhausted by an incessant recurrence of pustules all over the body.

Symptoms.—It is seldom that any other symptoms than those which have been mentioned occur in the course of the disease, except some occasional eruption on the arm, as roseola, strophulus, or lichen, or some unimportant abscess or boil on the same part.

Prognosis.—The prognosis is always favourable.

Diagnosis.—The circumstances of vaccination of the single vesicle, and that at the point of puncture, render it impossible to confound this disease with any other.

Treatment.—The patient should abstain from animal food during the course of the disease; the state of the bowels should be attended to, and occasionally some slight local treatment is necessary, when the arm is considerably inflamed.

Of the Poison of Syphilis.

Syphilis is a simply contagious disease, consisting of an ulcer termed the "primary symptoms," produced on any part of the body to which the poison may be applied, and also in a given number of cases of many "secondary symptoms," as cutaneous eruptions, warty growths; and also inflammation of the bones, of the ligaments, of the eye, of the nose, or of the throat. This disease often produces much unsightliness, frequently great suffering, and formerly many deaths; but in the present day, owing to the improvements in medicine, the mortality from this affection is trifling, only 142 deaths being recorded from it in the year 1839.

This disease is of modern origin, and first appeared in Rome towards the close of the XVth Century, supposed to have been brought from America by Columbus, but without any sufficient evidence. The epochs in its history are the gradual development of its laws, and the connexion of the primary with the secondary symptoms; also the introduction, first of mercury, then of sarsaparilla, and lately of the iodide of potash, into its treatment.

Remote Cause.—The combination of causes producing this disease is entirely unknown; but so dissolute were the manners of the times, that, in a few years, it spread over the whole of Europe, and has at length perhaps infected every country in the world. The disease is now entirely propagated by human contagion, and the poison in its habits is peculiar to man, for in no instance has matter taken from the primary sore produced any similar affection in animals.

Predisposing Causes.—The principal circumstances which predispose to syphilis are—impaired health, peculiarity of idiosyncrasy, neglect of personal cleanliness, intemperance, and climate.

In general the infection by this poison is more certain, its action more immediate, and its phenomena more severe, in proportion to the enfeebled health of the party. The effects of idiosyncrasy in predisposing to this disease will be seen, when it is stated, of the "filles publiques," some very few escape it altogether, and are never infected, while others may be said to pass their lives in the hospitals. Another remarkable instance of idiosyncrasy occurred in the case of twins born of infected parents, one of which was covered with a syphilitic eruption, while the other was perfectly healthy. The consequences of want of cleanliness and of intemperance in producing this affection are palpable. The effects of climate are remarkable in influencing the occurrence of syphilis; thus the admissions into hospitals for this complaint in the Windward and Leeward command are only 35 per 10,000 annually, while in Great Britain they are 181. The primary symptoms also are said to be milder in tropical than in northern climates, and perhaps owing to the greater cleanliness of the inhabitants. The secondary symptoms, however, have been thought to be more severe in Portugal, in the Bermudas, and in some parts of India, sometimes causing a large non-effective list, or a number of discharges from the service.

Age appears but slightly to affect the liability to this disease; for the infant at the breast, the adult, and even the aged occasionally suffer from it. The strong passions of youth, however, render it more common from early adult age to 30. The sexes probably suffer in nearly equal proportions.

Contagious.—The contagious nature of primary syphilis is generally admitted, for it is a disease which prevails exclusively among a class of persons indiscriminate in their sexual intercourse, while it is entirely wanting in those whose similar indulgences are guarded by a higher morality and a purer taste. Many persons in proof of this doctrine have voluntarily inoculated themselves, and the disease has in most instances followed. Ricord and Beaumés have also recently repeated Mr. Hunter's experiment of inoculating the diseased patient with matter taken from his own primary sores, and in an endless number of instances they have succeeded in producing "a specific primary sore."

The primary sore is very frequently followed by enlarged inguinal glands or bubo, and it has been a question whether matter from these parts will communicate the disease. The experiments of Ricord, however, have shown that a specific virus often can be obtained from the superficial ganglia, but not from the deeper-seated ones, unless the latter be contaminated by pus from the former. The pus also contained in the lymphatic vessels leading from a primary sore, or else in an abscess in its immediate neighbourhood, will also produce a syphilitic ulcer by inoculation.

It seems also established by Mr. Hunter, by Ricord, and by Beaumés, that pus from a syphilitic sore throat, or an inflamed periosteal membrane, or from any other part the seat of the "secondary symptoms," is incapable of producing any specific affection by inoculation, and consequently is not contagious, with perhaps two exceptions, or the ulcerated mouth of a syphilitic child, and also the "pustule muqueux" or warty excrescences, which sometimes form on the genitals. The ulcerated mouth of a syphilitic child, for instance, has sometimes occasioned ulceration of the nipple of the nurse that gave it suck, and this has been followed by slight or severe secondary symptoms. The cases, however, of this kind are few, and perhaps it may ultimately be shown that the disease may have been contracted in the primary form at birth, the mother being infected. The next form of "secondary symptoms" which is supposed to be contagious, are the warty excrescences growing from the genital membranes. Willan says, he has produced them in a healthy person by inoculation, while both Ricord and Beaumés have seen them spread from person to person in a manner difficult to explain, except on the hypothesis of contagion.

The intimate nature of the syphilitic virus is unknown, but its property of infecting is not immediately lost, for Ricord has preserved it in tubes in the same manner as vaccine lymph for seventy-three days, and then successfully inoculated with it.

Fomites.—The repeated instances of inoculation are proofs of the contagion by fomites. Ricord states that the nail is sometimes the instrument of transmission; and he gives instances of persons labouring under syphilis and the itch, who by scratching themselves had produced primary sores in different parts of the body.

Susceptibility not exhausted.—No prior attack, however severe, exempts the constitution in any degree from a second attack of syphilis. Even the existence of either the primary or of secondary symptoms does not prevent the patient from contracting other primary affections. Many unfortunate females in consequence of this law are scarcely ever free from the disease.

Co-exists.—The co-existence of typhus and syphilis, and of syphilis and erysipelas, is of daily occurrence. Syphilis and itch, syphilis and intermittent fever, are also very frequent. The frequent co-existence of syphilis and of gonorrhœa has given rise in the minds of some pathologists to the opinion that the two poisons are identical; but a multitude of experiments have shown that the matter of gonorrhœa will not produce syphilis, unless a chancre exists in the urethra. Neither will the matter of syphilis at any time produce gonorrhœa.

Modes of Absorption.—The poison of syphilis is introduced into the system by means of the cutaneous and mucous tissues.

Period of Latency.—The period usually observed to elapse after connexion till the appearance of the primary sore, is from four to eight days.

The period of latency which elapses before the secondary symptoms manifest themselves is usually long after the cure of the primary sore, or perhaps from six weeks to six months; but cases are numerous in which the period of latency of the secondary symptoms, and especially before the whole series is exhausted, is often singularly long. We constantly meet in the London hospitals with cases in which two, three, or four years have elapsed between the termination of the primary and beginning of the secondary symptoms, and some cases have occurred in which fifteen years have appeared to be the period of latency; and if this be true, a great part of life may pass away before the effects of the poison are entirely exhausted, and the disease eradicated from the system.

Pathology.—The theory of syphilis is that the poison is absorbed and mingles with the blood, and after a

Elementary Principles of Medicine.

certain period has elapsed, produces a specific inflammation in the part to which it was applied and introduced into the system, and which is termed the primary sore. The primary sore being healed, the disease is in many cases at an end, but in a considerable number of instances, the poison remains circulating in the system in a latent state, although disarmed indeed of its power of producing any further primary sore, till at varying and at sometimes very distant periods it causes many "secondary symptoms," or affections of different tissues, as of the skin, the throat, the nose, of the bones, of the periosteum, the ligaments, and also of the eye; not however that the whole of this long series is in all cases set up, for the poison more commonly exhausts itself on one or more tissues only. Such is the theory of this disease. The proofs of the law that the poison is absorbed and mingles with the blood, are the long series of secondary symptoms which are often set up, and at very distant periods from the time of contamination, and also the infection of the fœtus in utero, a circumstance which is supposed to occur in the ratio of 17 in 1000 in the children admitted into the Hôpital des Enfans Trouvée.

The law that the poison produces a specific inflammation in the part to which it has been applied and introduced into the system is so universal, that it is doubted whether it has any exceptions. Mr. Hunter, however, thinks the poison may be absorbed, and the glands of the groin inflame without any primary sore having formed. This form of disease is termed by the French pathologists "bubo d'emblée," and Ricord thinks he has seen it when it was impossible to discover any antecedent or concomitant primary sore, while Beaumés says he has inoculated with matter taken from these buboes, and produced primary symptoms.

The law that secondary symptoms follow the primary sore in a given number of cases is unquestionable, and the returns of the army give one case in fifteen as the proportion.

Primary Syphilis.

The primary ulcer is so much influenced by the constitution of the patient, his present state of health, and perhaps by some modification of the poison, that it is difficult to give any generic description of it. We should imagine ulcers resulting from inoculation must be most uniform in their character. Ricord however states, that although inoculation as a general rule gave a characteristic ulcer, yet they often presented differences so great as apparently to constitute different diseases. Indeed he adds, it is not the form, the induration, or other material circumstance which denotes the peculiar ulcer, but rather the pus it secretes, and the poisoning it gives rise to. All other conditions vary; the secretion and its results alone remain identical. The primary sore, then, is endless in its character, being sometimes an excoriation so slight as hardly to attract the notice of the patient. Sometimes a pimple which itches, or a pustule containing pus, and which being broken incrusts, and under this incrustation is an eating ulcer, and this ulcer may take every character, from the superficial patchy excoriation to the deep wide-spreading phagedenic gangrenous ulcer destroying the entire organ. Many attempts have been made to arrange these different ulcers into species. The most practicable of these arrangements is into the venerola simplex, venerola superficialis, venerola indurata, and venerola phagedenica.

Of these the venerola simplex is the most usual form, and has this peculiarity; that at the time of granulation there is an elevation of the edge, and a rising up of the surface of the sore, which eventually becomes exalted like a fungus above the level of the surrounding parts, attaining its greatest height from the fourteenth to the eighteenth day, and on its cicatrizing leaving a permanent depression, resembling that left by the cow-pox or variola. The time required for healing this sore is generally from four to six weeks, and in general the disease runs its course so mildly, that except the glands in the groin enlarge, or the patient suffers from phymosis or paraphymosis, his general health is seldom impaired. The other forms of venerola may be inferred from their designation; and the reader is referred to the works of Mayo, Skey, Ricord, Hunter, &c., for a more particular description of their course.

The following table, from Boyer, *Pratique de la Syphilis*, 1836, is an approximation to the frequency with which different parts are attacked with primary syphilis:—

IN THE MALE.

Fossa between the glans and prepuce	269
Orifice of prepuce	154
Frænum	132
Internal surface of prepuce	127
Surface of glans	49
Outer surface of the prepuce	45
Body of the penis	41
Orifice of the urethra	11
Scrotum	5
	833

IN THE FEMALE.

Fossa navicularis, or posterior commissure, and between this commissure and the vagina or fourchette	41
Internal surface of the nymphæ or petites lèvres	37
Meatus urinarius	12
Labia externa	6
Carunculæ myrtiformes	5
External surface of the nymphæ or petites lèvres	3
	104

The *number* of primary ulcers is extremely variable, sometimes only one, frequently a plurality, as four, five, or six, while Boyer counted in one person sixteen, and in another twenty-four. In general they are more numerous in women than in men, the surface on which they usually form being more extensive. When there is a plurality of ulcers, they are often of very different characters, some presenting the Hunterian indurated base, while others are free from all hardness.

The *form* of the primary ulcer is more or less round, and its *size* is generally in the inverse ratio of the number, but this is not constant. The glans has often only one chancre, and this seldom exceeds the superficies of a sixpence, but occasionally it extends from the orifice of the urethra to the insertion of the prepuce. On the internal surface of the prepuce they are always large, those of the orifice generally round and small, while those of the external surface of the prepuce, of the body of the penis, and on the scrotum, are usually large. Boyer speaks of having seen them of the size of half-a-crown.

The duration of the primary ulcer is very various; for some ulcers, from which secondary symptoms will

result, may heal in a few hours, while Ricord has inoculated from ulcers which have lasted eighteen months. The venerola simplex may heal in a few days, more commonly in about four to six weeks, the venerola indurata in two to three months, while the venerola phagedenica, although it may destroy the part or the patient in a few days, yet, in any other case, is slow in healing.

The cicatrization of primary ulcers offers some differences. When they are superficial, they often heal and leave no trace; but in most cases they have an indelible and visible cicatrix. The Hunterian chancre leaves a deep cicatrix, but without any contraction or diminution of surrounding parts.

Primary ulcers often occasion, as concomitant circumstances, phymosis or paraphymosis, and that enlargement often followed by suppuration of the inguinal glands termed bubo. The duration of the bubo is very various; it seldom lasts less than from four to eight weeks, and often never entirely disappears.

The proportionate number of syphilitic persons suffering from bubo is one in seven, and from phymosis and paraphymosis one in two hundred and six; and it is calculated there are ten cases of phymosis to one of paraphymosis.

Secondary Syphilis.

The secondary affections of the syphilitic poison embrace a greater variety of disease than results from the action of almost any other poison, as inflammation of the skin, of the throat, of the nose, of the bones, cartilages, and ligaments; also of the eye, and lastly, the formation of many adventitious warty growths.

It is the opinion of some pathologists, that the nature of the primary sore influences the nature, as well as the number, of the secondary symptoms. But every practitioner must have observed so many exceptions to this rule, the severest secondary symptoms sometimes following the slightest and most tractable primary sore; and, on the contrary, the most formidable primary sores being often followed by the mildest secondary symptoms, that the fact is far from established. If, however, we take the nature of the primary sore to be an indication of the constitution of the patient, we can easily understand why similar secondary symptoms may follow occasionally a similar primary sore, and thus form distinct groups or families.

Cutaneous Affections.—Of all the secondary symptoms the affections of the skin are the most remarkable, the same poison producing in different individuals almost every chronic variety of disease to which the skin is subject. There are, however, certain specific differences which distinguish the syphilitic from the ordinary affections of this tissue, which they similate, as the shade of colour, which is of a deeper red or "copper colour;" also a tendency, on subsiding, to stain the natural pigment of the affected part with a dusky hepatic spot, of the same size and form as the original eruption—a discoloration which often long continues to disfigure the patient, together with a greater tendency to run into chronic ulceration. It is also a characteristic of syphilis, that two or three dissimilar eruptions may co-exist in the same patient, and likewise that they are seldom accompanied by itching.

The syphilitic eruptions admit of being classed under the orders papulæ, squamæ, exanthemata, pustulæ, vesiculæ, tubercula, and maculæ of Willan.

Papulæ Syphiliticæ.—The most usual forms of venereal papulæ are lichen, some forms of prurigo, and scabies. The species of lichen met with in syphilis are the lichen syphiliticus and the lichen syphiliticus agrius, or *scabby lichen.*

The *lichen syphiliticus* is an eruption consisting of a number of small, firm, solid elevations, or papulæ of the skin, which inflame and desquamate, leaving the inflamed part covered with a scurf; and among them may occasionally be seen papulæ, with acuminated vesicles containing lymph or pus. The colour of the lichenous spots varies from a pale red to a deep crimson, deadened by the exfoliation of the cuticle, which gives them an appearance of scaliness. As each lichenous spot declines, it leaves a brown or copper-coloured stain of the same size as the original affection, and which frequently lasts a considerable time. This variety often consists of a series of crops, and each crop is frequently ushered in with a smart attack of fever, which does not always subside on the appearance of the eruption. It is usually accompanied by pains in the limbs, which are most severe at night. The papulæ of this eruption are often very numerous, particularly on the face; also on the alæ of the nose, and the commissure of the lips, as also on the back, abdomen, and arms. This form seldom ulcerates, and is not accompanied by pruritus.

The time of the appearance of this eruption after infection is extremely uncertain; but Mr. Carmichael has observed it to occur in the fourth or fifth weeks. Its duration is extremely capricious; sometimes it will decline in a few days, while it may last many weeks or many months. It is distinguished from the ordinary forms of lichen by the papulæ being more numerous and more confluent, and by their running more frequently into small oval clusters, whose greatest diameter may equal that of a shilling; and also by their being separated from each other by interspaces covered with papulæ.

The *lichen syphiliticus agrius* differs from the preceding variety in the eruption appearing without fever, in its being of a brighter red or copper colour, and by discharging a thin fluid, which concretes into a scab; so that should the disease be neglected, the clusters have a tendency to ulcerate. The ulcerated papulæ are generally in large patches, sometimes exceeding two inches in diameter. The lichen syphiliticus is exceedingly common, but the lichen agrius is less so. They often co-exist with most of the syphilitic eruptions, as well as with many other of the secondary symptoms, as affections of the eye, of the bones, or of the throat.

The *prurigo syphilitica* is a less frequent form of cutaneous eruption than the lichen syphiliticus. It attacks principally the pudenda of both sexes, often spreads to the thighs, and discharges an acrimonious matter, which inflames and excoriates the parts over which it flows; or should the eruption occur in the folds of the limb, of the opposite parts with which it is in contact.

The *scabies syphilitica* is the third form of papular eruption, and greatly resembles the ordinary forms of scabies papuliformis, but it is in no degree vesicular, neither is it accompanied by pruritus. It principally attacks the arms, thighs, and trunk of the body, and may co-exist with every form of secondary syphilis.

Squamæ Syphliticæ.—The squamous forms of syphilis are lepra syphilitica and psoriasis syphilitica.

The syphilitic lepra appears in circular patches, which resemble those of the lepra nigricans in size and colour, but are not similarly incrusted. The harshness and dryness also of the skin, so remarkable in the common forms, do not occur in syphilitic lepra. Each patch originates from a small, hard, reddish protuberance, whose circumference gradually increases. The patches are generally distinct, and seldom exceed the size, says Willan, of a shilling, though sometimes they are much larger. They have a raised edge, the central part appearing a flat surface covered with thin white scales. The leprous form of syphilitic eruption takes place, like other venereal eruptions, at very different periods after infection in different cases. If no medicines are employed, it is said to terminate in venereal blotches.

This eruption may be generally diffused over the body, or it may be limited to one or more parts, as the scalp, neck, shoulders, or to the thighs, legs, and arms. When it forms in the gluteal fissure, on the scrotum, or any other part where two surfaces are in contact, the cuticle, instead of desquamating, is smooth, of a dull white or grey colour, and covered with an unctuous matter.

There are three kinds of psoriasis syphilitica, or the psoriasis syphilitica diffusa, the psoriasis syphilitica palmaris vel plantaris, and the psoriasis syphilitica guttata.

The *psoriasis Syphilitica diffusa* scarcely differs from the ordinary forms of this eruption, except in being something deeper in colour. Its most usual seat is the posterior portion of the fore arm, or the anterior portion of the leg or knee; but it may attack many other parts, as the forehead, breast, back of the neck, or pubis. It not unfrequently accompanies periostitis of the tibia or ulna.

The *psoriasis Syphilitica palmaris vel plantaris* is described by Rayer in the following terms:—"In the palms of the hands, and soles of the feet, syphilitic psoriasis is almost always distinct. It makes its appearance by a number of spots, from three or four lines in diameter, but little or not at all prominent, and of a yellowish colour very similar to that of the thick horny indurations of the cuticle, often seen in the palms of the hands. If, at this period of the disease, a portion of the whole of the epidermis be removed, a thin layer of a yellowish substance will frequently be found deposited between the surface of the cutis and the detached cuticle. Small lamellar scales are very regularly thrown off from the palmar surface of the hand, and sole of the foot, which almost always present a mixture of yellow, of red, of violet, and of copper-coloured spots, or blotches surrounded by an epidermic rim. The spots of syphilitic psoriasis are occasionally arranged in the form of a large ring, in the palm of the hand: at other times they present the appearance of a kind of arc of a circle, something like psoriasis gyrata."

When this eruption affects a fold of the skin, as between the toes, or the fingers, or the nates, or thighs, the skin is elevated into a soft flat or convex surface, at first moist and whitish, then excoriated and red, and at length ruptured into cracks, rhagades, or fissures. That part of the finger or toe on which the nail is placed is often attacked, when a separation of the nail follows, and the affection is now termed syphilitic onychia.

"If mercury be not employed," says Mr. Carmichael, "the eruption proceeds to ulceration in the following manner:—Each spot is covered with scales, or by scurf, which is thrown off and succeeded by another; and every succeeding scurf which is formed becomes thicker than the preceding, till at length it forms a crust, under which matter collects, and it becomes a true ulcer, in which state it spreads very slowly."

The *psoriasis Syphilitica guttata* may appear partially or generally on every part of the body, but it is principally on the extremities and on the scalp that it is most frequently seen. It appears in irregular round patches of two to four lines in diameter, more elevated at the centre than at the circumference, of a reddish colour, covered with one or more scales, which are readily detached, and on falling off leave a hard, dry, polished surface. Biet observes, it is always surrounded by a whitish edge, similar to that which marks the disc of a vesicle, but this is not constant.

The *psoriasis preputialis* appears in the form of deep chaps or cracks around the margin of the prepuce, which, like similar affections of the lip, are extremely irritable, and apt to bleed whenever any attempt is made at retraction, but which, from the loose cellular texture of the prepuce, are in this case generally much deeper. The discharge is generally of a glutinous nature, sometimes purulent if improperly treated; the healing process is often very tedious. This disease is apt to give rise to bubo, or enlargement of the inguinal glands.

Exanthemata Syphilitica.—The species of this genus, though very numerous when they arise from ordinary causes, yet in syphilis are chiefly limited to four kinds, or to the roseola syphilitica febrilis, the roseola syphilitica annularis, the roseala syphilitica diffusa, and to the purpura syphilitica.

The *Roseola Syphilitica febrilis* is an eruption which appears either on the face, chest, trunk, or extremities, and is not to be distinguished except by the previous history from the roseola simplex of Willan. It is preceded and accompanied by a sharp febrile attack, lasts about a week, and then terminates by desquamation.

The *Roseola Syphilitica annularis* consists of a number of patches, of a dirty pink or copper-colour, generally distinct, seldom more than half an inch in diameter, and very much resembling the eruption in measles. These patches, when minutely examined, appear to be formed by the aggregation of four or five slightly-coloured points or stigmata slightly prominent; and, as in measles, their colour is evanescent on pressure. They frequently cover nearly the whole of the body, but most principally affect the neck and scalp, the alæ of the nose, the commissure of the lips, and also the forehead. The arrangement of the patches on the forehead is sometimes peculiar, and forms one of the many corona veneris of this disease. This eruption is often tedious, most generally terminating in slight desquamation; but, like all syphilitic eruptions, has a tendency to ulcerate. On dying off it leaves a brown hepatic spot, that for many months continues to mark the form and seat of the original disease.

The *Roseola Syphilitica diffusa* is a diffuse inflammation of the skin, generally of considerable extent, and of a deep red colour. Its usual seat is the back and neck. This eruption frequently co-exists with tubercula syphilitica, and on dying away leaves no discoloration of the rete mucosum.

The syphilitic forms of purpura are, purpura syphilitica and purpura syphilitica hæmorrhagica. Their varieties are not dissimilar to the ordinary forms of purpura described by Bateman. The stigmata of the first variety are extremely minute, sometimes a mere point, not exceeding the bite of a flea. In the second, how-

ever, they form large patches, sometimes as big as the palm of the hand. The arms, thighs, and trunk of the body are the principal seats of these forms of disease, which not unfrequently precede the squamous and pustular forms of syphilis, and often accompany the papular and tubercular eruptions. The erythemata syphilitica are rarely followed by iritis, but they are not unfrequently accompanied by some affection of the bones. They also often accompany the papular and tubercular eruptions.

Pustulæ Syphiliticæ.—The ecthyma syphilitica is the only known pustular form of syphilitic cutaneous disease.

The *Ecthyma Syphilitica* is an eruption of pustules about the size of a small-pox pustule, having a hard circular inflamed edge and base. The pustules are, therefore, phlyzaceous. Each is surrounded by a copper-coloured areola, which discharges a sanious matter, which scabs, and on healing leaves a deep cup-like cicatrix, which is permanent. They form principally on the forehead, alæ of the nose, and beard; and as they have a tendency to become confluent, often produce a most unsightly corona veneris. This disease is at all times chronic, and if neglected is said to push forth fungoid vegetations.

Rayer has given a form of ecthyma syphilitica, in which the pustules are psydracious, and consist of minute pustules irregularly circumscribed, slighly eminent, and forming a scab. He represents them as numerous, often confluent, and on rupturing as discharging a thin watery humor, which forms an irregular incrustation. A case of this rare kind was a short time ago in St. Thomas's Hospital, in which the eruption appeared first on the legs, where it left many large rupia like sores, and subsequently a tolerably large crop appeared in the neck.

Vesiculæ Syphiliticæ.—It is doubtful whether any form of this genus exists, except rupia and herpes preputialis.

The *Rupia Syphilitica* consists of a number of dusky brown tumors of considerable size, each of which is surmounted by a vesicle, which breaks and discharges a clear transparent glutinous fluid that concretes into a scab, having a peculiar conoidal form resembling a limpet shell, in consequence of each successive formation being larger than the one that preceded it. Beneath this remarkable incrustation, however, a slow process of ulceration goes on, so that on the scab falling off a wide-spreading ulcer is seen, sometimes superficial, but at others deep and foul. In the latter case it occasionally penetrates to the tibia, the ulna, the clavicle, or to the bones of the nose, or of the cranium, causing ulceration and caries of those parts. This ulcer heals from the edge, and when completely healed the cuticle, according to Rayer, repeatedly desquamates, a result, however, by no means constant. On healing, the ulcer leaves a permanent cicatrix.

This disease usually appears on the legs and thighs, or on the arms or back. The face and scalp are also often its seat, as also every part of the nose, eyebrow, and even the inner eyelid, and it may form on every other part of the body. The number of these tumors is seldom great, often not more than two or three, and seldom more than twenty. In size they generally vary from a small nut to a walnut. Their duration depends, in a great measure, on the treatment; for if left to themselves, they often continue open sores for many months.

The most remarkable circumstance connected with rupia is the extreme depression of the constitution which accompanies it; for many strong, and even robust, persons become greatly worn, and even emaciated, under its influence, and in a degree by no means accounted for by the extent of the ulceration. In many instances this disease has proved fatal.

The herpes preputialis first appears as a cluster of vesicles which scab, and this being removed, a number of small circular ulcers is seen, with a yellow or white surface, often running into one another, with an edge sometimes a little raised, and of which the healing process is sometimes tedious.

Tubercula Syphilitica.—The term tubercle, in dermatology, does not imply that peculiar substance which bears that name when deposited in the lungs, but is defined to be a small, hard, superficial, isolated tumor, or elevation of the skin, resembling a wart in character, ordinarily isolated, but sometimes confluent, and whose natural course is to terminate in slow ulceration. Of tubercula syphilitica there are two varieties, or tubercula syphilitica rubra, and tubercula syphilitica flava, and these may be either round or flat.

The *Tubercula Syphilitica rubra rotunda* consists of a number of firm, solid, moveable tumors, of a conoidal form, and about the size of a split pea, *red*, not painful, nor the seat of pruritus. They are usually very numerous, and appear sometimes on the face, but more commonly on the trunk of the body, and especially over the back and shoulders. This disease often assumes a particular form, and sometimes, if neglected, ulcerates. Its duration is very various, and though it may terminate in a few weeks, it usually lasts two, three, or four months, or longer.

The *Tubercula Syphilitica rubra plana* consists of a number of flat tubercles, having an equal thickness over their whole surface, except at the edge, where it is in more prominent relief by a line or more. Their colour is of a livid red, and their size varies from a lentil to the palm of the hand. This variety has a great tendency to ulcerate, and then the edge thickens and rises, so that the body of the tubercle generally appears depressed. The swollen surface becomes fissured and secretes a faint dirty white matter. These fissures sometimes increase to considerable ulcers, and on healing their cicatrices at first resemble yellowish or violet-coloured blotches, and do not acquire a natural colour or proper pliancy, until after a very long period. It is remarkable also to observe these ulcers, as in cancer, healing in one direction and spreading in another. They are attended with little or no pain, and with little inflammation beyond their edges, which are deep and sharply cut. Sometimes, however, they assume a phagedenic character, so that when they attack the face they do not present regular cicatrices, but unsightly bands, or rather seams, as after severe burns, or in the lupus exedens.

The duration of the flattened form is always exceedingly chronic, and when ulcerated the process of healing is extremely slow. Its principal seat is the pudendal region, as the labia majora, glans, or scrotum; sometimes they form round the anal aperture, and their fissures may then penetrate the rectum. More commonly, however, they form on the inner part of the thighs, the groin, and over the gluteal muscles, or on the trunk; they are also occasionally seen on the face, lips, and ears.

The *Tubercula Syphilitica flava, vel rotunda vel plana*, does not differ from the red variety, either in seat, form, duration, or termination, or in any other respect than the tubercle preserving the colour of the skin. Sometimes, however, these pass into the red state.

Among the tubercula must be classed those many vegetations, excrescences, or warts which are so frequent in syphilitic patients.

These vegetations are developed in two different manners, each influencing the form they afterwards take. In the one the vegetation first appears about the size of a large pin's head, and is most commonly white, but in some few instances red, and we feel on the surface inequalities, as in a strawberry. The vegetation increases till it is termed cauliflower, cockscomb, or, when springing from distinct sources, asparagus, or other familiar name.

This species also includes all those varieties which have been classed under the heads of rhagades, fici, condylomata, &c. It also includes those hypertrophied and elongated labia or nymphæ, which are often of monstrous growth, and hang pendent for many inches. In general they grow from those parts which were the seat of the primary sore. These growths are most common in the female.

Maculæ Syphiliticæ.—Maculæ syphiliticæ are partial discolorations of the skin, forming patches which vary from a sixpence to the size of the open hand. They are either of a yellow or brown copper colour, and appear to depend on an alteration of the pigment of the rete mucosum. In general the maculæ terminate without any other sensible alteration than of the colour of the skin. But in a case lately in St. Thomas's Hospital these patches exhibited the remarkable phenomenon of ulceration under the cuticle. The ulcer thus formed had a sharp edge, as though made by a punch, and its base was about two lines below the surface of the skin in every part. It was covered by the cuticle, not detached, but puckered up, so as to lie loosely upon it, and presented a most beautiful specimen of the dry ulceration of Mr. Hunter. The maculæ form principally on the trunk, frequently covering a large space, and often on the face and extremities. The duration of this form of cutaneous eruption is always extremely long, and may last many months or even years.

Of the Syphilitic Diseases of the Osseous System.—Next to the dermoid tissue, the osseous system is the most frequent seat of the secondary action of the syphilitic poison, and its diseases are important, as they are frequently of long continuance, often disfigure the patient, and are in most instances the cause of severe suffering. Some pathologists, in an excess of scepticism, have doubted the action of the syphilitic poison on the bones, but the public have entertained no such difficulty; and the poet whose Court of Death we have before quoted, embodies this doctrine in the following lines:—

> " A haggard spectre from the crew
> Crawls forth, and thus asserts his due :—
> ' 'Tis I who taint the sweetest joy,
> And in the shape of love destroy ;
> My shanks, sunk eyes, and noseless face
> Prove my pretensions to the place.' "

The principal syphilitic affections of this system are inflammation of the periosteum, and inflammation with enlargement, ulceration, abscess, or necrosis of the bones themselves. It is remarkable that these affections differ in many important circumstances, according as they occur in the flat or in the long bones.

The periosteum of the long bones is subject to syphilitic inflammation, which probably often extends to the bone itself. The result of this inflammation is thickening of the periosteal membrane, and the deposition of a hard membraniform substance on the surface of the bone, and which, if recent, may be removed by maceration. This newly-formed part is termed " *a node*," and it may be absorbed, may ossify, or may ulcerate. The termination by absorption, however, is seldom seen, unless the disease be recent, and the patient early submitted to medical treatment. The termination by ossification was formerly the most frequent, and in this case points of ossific matter are first deposited throughout the membranous substance of the node, which gradually multiply until they form a bony mass, or tumor of greater or less size and solidity attached to, and at length forming an integral part of the bone. The node thus ossified is, under the most favourable circumstances, only slowly absorbed, and many years may perhaps pass away without any great reduction, during which the patient is liable to continual relapses.

The hard periosteal node, whether membraniform or ossified, formerly often terminated by suppuration; the pus effused forming a superficial, fluctuating abscess, surrounded by the sharp edge of a deep cup-like ulcer. The pus thus formed may be absorbed, and the abscess heal, or else it may burst, or make its way to the surface, and in the latter case the bone may be exposed, or so affected that it may exfoliate.

The periosteal node just described does not attack all the long bones equally, never attacking the phalanges of the fingers, or the bones of the feet, but has its seat almost exclusively on the bones of the leg, of the fore arm, and of the clavicle. Neither does it attack all these bones with equal frequency, for the hard node exists much more commonly on the tibia than on the fibula, and on the ulna than on the radius, while the clavicle is only occasionally the seat of this affection. When the tibia is affected the centre of the shaft of the bone is more commonly the part diseased, then the lower third, and more rarely the upper third of the bone, and both tibia are more commonly affected than one. When the ulna is affected, it is the upper third on which the node more usually forms, and one ulna is more usually diseased than both. It is doubtful whether the femur or the os brachii is subjected to this form of node, although it seems proved that their shafts are occasionally the seat of syphilitic inflammation.

The long bones also are sometimes the seat of a disease termed " the soft node," or more popularly the " gummy node." This disease consists equally with the former, of an inflammation of the periosteum; but according to Desruelles, of its external surface, and also of the intercellular tissue of the muscles, and of the ligaments terminating in the secretion of a fluid of the consistency of gum water, of a thin jelly, or of still greater firmness. This form of node is of so rare occurrence, that it is doubtful whether it has been rightly attributed to a syphilitic origin. It is attended with less pain than the hard node, except it presses on a nerve, when every motion of the limb is excruciating. It is usually indolent, but has a tendency at last to ulcerate, sometimes extensively and deeply, so that not only exfoliation but death has followed. The tumor is generally moveable, and the skin, unless near bursting, of its natural colour. Its usual seat is either the fore arm, the leg, or the head. This node is of difficult cure, and its duration indefinite. Its fluid contents require to be analyzed.

The syphilitic poison may also cause inflammation of the substance of the long bones, especially of the thigh bones and the phalanges of the fingers, terminating in enlargement, in ulceration, in abscess, in caries, or in necrosis of those parts.

The periosteum of the cranial bones is often affected in syphilis, but the node now formed follows, to that of the long bones, entirely different laws. When the syphilitic poison produces nodes on the cranium, we might be led to imagine, from the external appearance, and from the firmness and resistance of the node, that it was of exactly similar formation to that of the tibia and ulna, and that a membraniform substance, ossified or otherwise, was deposited on the bone. But on a careful examination of many syphilitic crania, no membrane or ossific matter has been found in the node, so that it is probable that the hard, immoveable, external cranial node is caused by an infiltration of the soft parts, bound down by their peculiar aponeurosis. Even in those strangely worm-eaten skulls in which deposition and absorption, thickening and thinning, newly-formed parts and immense voids, are so singularly intermixed, no membraniform or ossified substance, similar to that of the tibial node, is to be seen. This node much more frequently suppurates and ulcerates than the nodes of the long bones. Its more usual seat is the frontal and parietal bones, and there is seldom more than one or two, or at most three.

If the disease proceeds the bone itself is affected, and ulceration and extensive exfoliation of the outer table often takes place, and the disease sometimes spreads, even to the inner table, exposing the membranes of the brain. A portion of the cranial bones being destroyed, pathologists are not agreed in what manner the injury is repaired; but the more common opinion is that the void is first covered with soft parts, and then that a slow process of ossification goes on, so slow that a long period elapses before the defective part is repaired by ossific deposit.

The syphilitic poison may also fall on the bones of the face; and we have many specimens in our museums, in which the ossa malarum and the bones of the orbit are extensively eroded from ulceration. But syphilis is now so easily and so completely checked by medicine, that any affection of these bones is extremely rare.

The bones, however, of the nose and palate are still found to be frequently diseased. In these cases the affection may begin by inflammation and ulceration of the mucous membrane, but more commonly perhaps the disease is seated in the bones themselves. This inflammation, in whatever manner set up, usually terminates in necrosis, sometimes so extensive that the vomer, the ossa unguis, the turbinated bones, or a considerable portion of them, exfoliate. The cartilages, as well as the bones of the nose, are also frequently involved in the disease, so that the hard parts being thus withdrawn the soft parts fall in and produce a permanent and most unsightly deformity. Thus the alæ of the nose may alone be destroyed, or else the whole of the proper bones may exfoliate, and the soft parts sinking, nothing but the mere tip of a nose is to be seen.

It is seldom that the bones of the nose are affected in any considerable degree without the palate-bones ulcerating, and also exfoliating to a greater or less degree. In this latter case it is the superior maxillary bone, and not the palatine bone, which forms only the posterior fifth of the palatine arch which is affected, and usually the middle of the horizontal portion of it, or only in a few instances posteriorly towards its union with the palatine bone. At other times, but more rarely, the anterior portion of the superior maxillary bone, and which contains the alveolar processes of the incisor teeth, is its peculiar seat. It is generally, but not constantly, the suture which unites the two superior maxillary bones which is the part attacked, and more frequently one bone affected than both. The exfoliation of the necrosed portion always leaves an incurable perforation, unless it be extremely small indeed.

In general the periosteal affections of the cranium and of the long bones occur from a few weeks to three or four years after contamination, and are accompanied by a degree of pain and tenderness almost amounting to agony, and in a short time greatly reduce the patient. On the contrary, however, the affections of the nasal and palatine bones, even when the devastation is excessive, are seldom accompanied by severe pain. In affections of the nose most commonly the patient's attention is first awakened by a swelling and uneasiness of the parts rather than by pain. These symptoms are followed by a discharge from the nostrils, at first small in quantity, serous and inodorous, which often concretes into a thick and troublesome scab. As the disease, however, advances the discharge becomes purulent, mixed with blood, and when the bone is necrosed sometimes insupportably fœtid. In this state the disease is termed ozena or ozema. There are cases in which the mucous membrane is so entirely removed that we can see the denuded bone, while we can almost always detect it by the probe.

When the palate-bones are diseased the discharge from the mouth is seldom considerable, except in a few instances, when the quantity from the antrum is distressingly large. The soft parts at length ulcerate, and exfoliation of a part of the arch follows. When exfoliation has taken place there is always an aperture by which air, and also liquids, can pass from the mouth into the nose. As long as the aperture is small the consequences are rather disagreeable than inconvenient; but when large the voice is altogether changed, and the patient speaks through his nose. Deglutition is also difficult, because the aliment can no longer be pressed against the palatine arch without passing wholly or partially into the nasal cavities. Another inconvenience likewise results, or the occasional discharge of the nasal mucosities into the mouth. The duration of the syphilitic affections either of the nasal or palatine bones, if left to nature or improperly treated, lasts for many months, and only terminates after great destruction of parts. Under a judicious treatment a cure is generally effected in a few weeks, and without disfiguration.

The cartilages, especially those of the sternum, are the occasional seat of the secondary affections of the syphilitic poison. The opportunities, however, of examining these parts are few, since the disease in almost every instance is cured; but the symptoms are those of inflammation, with great thickening, except in some few cases when ulceration and perhaps necrosis follow.

The fibrous capsules and the ligaments which surround and unite the articulations of the larger joints are often attacked, and form a large amount of the cases of secondary syphilis. These affections may be either acute or chronic, and do not essentially differ from those of acute or chronic rheumatism. Boyer states that articular dropsy is a common result, and which terminates in an impossibility of extending the

affected limb. Inflammation of the interior of a joint, especially of the elbow-joint, is by no means unfrequent. Pains similating rheumatic pains, and enlargement of the joints of the finger, as in gout, are likewise common. The duration of this class of affections is often long, and the treatment unsatisfactory.

Of Syphilitic Diseases of the Throat.—The parts next in frequency of attack and severity of symptoms after the cutaneous and osseous systems are those of the throat, which may be divided into angina syphilitica mitior and into angina syphilitica gravior.

The *angina syphilitica mitior* has many grades. It may be limited to a slight blush of inflammation, which may resolve, and the disease be at an end; or it may be characterized by an exceedingly hard and enlarged state of the tonsils, whose superficies is covered by patches of a viscid mucus or lymph, and at a subsequent stage by a number of small superficial ulcers. In other cases the tonsil is much less swollen, and a small chronic ulcer forms on it, sometimes of no great depth, while at others there is a fair loss of substance. Again, another form of syphilitic sore throat is when the parts are little swollen, but a superficial ulcer with a distinct edge spreads far and wide, healing in some parts and spreading in others, after the manner of a superficial phagedenic ulcer. This description of ulcer is often of long duration and difficult of cure.

The *angina syphilitica gravior* is characterized by no very considerable enlargement of the tonsils, but the inflammation is usually extensive, embracing the tonsils, velum palati, the uvula, and very commonly the pharynx. The inflammation is also much more asthenic, and usually begins by a diffuse redness of the mucous membrane of the throat generally, and in a few hours a foul and deep ulcer forms on each tonsil, having a broken-down irregular edge and a base covered with a dirty ash-coloured slough, the whole surrounded by a deep-coloured erysipelatously inflamed margin. The ulceration of the velum palati may begin either on the anterior or posterior surface of that membrane: in the latter case, if the disease be rapid, the velum may be destroyed almost before the disease is discovered, or even suspected to exist.

The uvula also is usually attacked at its base, generally at the posterior part, where an eating ulcer forms, and so rapid in its course that the uvula is constantly seen hanging in the fauces by a mere shred, so that the least delay in the administration of proper remedies is often followed by the entire loss of that part. Indeed, in the greater number of cases it is already detached before the patient is admitted into the hospital. From the tonsils and soft palate the inflammation may spread to the arch of the palate, or up the nasal fossæ, and thus lay the foundation of the destruction of the nasal and palatine bones.

The most appalling symptom, however, is when the inflammation extends to the pharynx. In this case the ulceration may be so situated as to be hid by the velum or by the root of the tongue, and, thus concealed, may make extensive ravages before it is discovered. More commonly, however, a single ulcer forms in the central and visible part of the pharynx, having an irregular broken-down edge, a dirty base, and surrounded, as in the former case, by a wide extent of angry erysipelatous inflammation. This frightful ulcer sometimes continues to spread as far as the eye can reach, so that the whole back of the pharynx is often one universal foul sore, sometimes penetrating so deeply that the spinal bones may be both seen and felt.

From the pharynx the inflammation may extend to the Eustachian tube, and the patient be rendered either temporarily or permanently deaf. Occasionally it involves the glottis, epiglottis, and even the larynx: when the larynx is affected the symptoms are, difficulty of breathing, with the stridulous whispering voice of croup, constant cough, and copious expectoration. The epiglottis has also been known to slough off, and then the patient can only swallow by holding his nose. Mr. Carmichael gives two cases of sudden death in the Lock Hospital from foreign bodies under these circumstances slipping into the trachea; and Mr. Mayo another, in which the patient died of ulceration of the lingual artery with hæmorrhage, notwithstanding a ligature was applied round the common carotid. When this pharyngeal disease terminates favourably a cicatrix forms, much whiter than the mucous membrane, striated and banded in every direction; and as it has less vitality than the membrane for which it is a substitute, it is liable to frequent but slight relapses. If the patient falls the throat becomes dry and brown, the pulse rapid, great restlessness supervenes, the legs swell, and the patient dies with the worst symptoms of hectic or continued fever.

Syphilitic angina is rarely accompanied by fever in the early stages, and this is the great diagnostic symptom which distinguishes it from the ordinary forms of sore throat, for it is needless to say that the copper colour of the inflammation attributed to it by some writers never exists. If left to itself, syphilitic angina is of almost endless duration, and sometimes of fatal termination. It often co-exists with every other secondary symptom.

Of the Syphilitic Diseases of the Eye.—The eye is less frequently affected by the syphilitic poison than the skin, the bones, or the throat, but still inflammation of this organ is by no means unusual, and its principal seats are the conjunctiva, the transparent cornea, the iris, and, judging from the degree in which the eye is pained by light, the retina, and perhaps also the entire globe of the eye.

Syphilitic inflammation of the *conjunctiva* may exist *per se*, or it may be conjoined with iritis, and the latter is much the most frequent. Its pathological character is diffuse inflammation, of greater or less extent, of the conjunctiva, varying from an arborescent state of the vessels to a general congestion, changing the brilliant white of this membrane to a livid red. Immediately around the cornea is a zone of still deeper intensity, which strikingly contrasts with that transparent tissue.

The *transparent cornea*, though nourished by vessels carrying transparent colourless fluids, is nevertheless susceptible of high inflammation. This inflammation occasionally exists *per se*, and may terminate by effusion of lymph or by ulceration. When lymph is effused it is poured into the lamellated structure, so that the eye is dull and the cornea nebulous or opaque; and if it be deposited generally over the pupillary portion, the membrane becomes impenetrable to light, and blindness is the consequence. If the disease proceeds, red vessels are seen to shoot into the effused lymph, and the superficies of the cornea frequently ulcerates.

The most remarkable affection, however, in syphilitic ophthalmia is *iritis*, which usually accompanies the preceding forms of the disease, and its termination may be

by resolution, the throwing out of lymph, or by the effusion of pus. In general the syphilitic inflammation attacks the posterior rather than the anterior surface of the iridial membrane, which becomes thickened, the pupil contracted, and often so diminished as scarcely to exceed the size of a pin's head. The iris thus contracted generally forms adhesions more or less partial, so that the pupillar edge appears puckered, irregular, and, instead of a circular, often takes a polygonal shape, with three or more sides. The inflammation, however, is rarely confined to the posterior, but very constantly involves the anterior surface of the iris. "In this case," says Mr. Lawrence, "the iris loses its brilliancy, appears dull and dark, and the beautiful fibrous arrangement which characterizes it in its healthy state is either confused or entirely lost; a light-coloured iris assumes a yellowish or greenish tint, a dark-coloured iris a reddish brown." Vessels carrying red blood are also now seen radiating on the outer surface, often depositing lymph of a reddish brown or ochre colour, or tinged with blood in various manners, and occasionally in such quantities as to hang pendulous in the outer chamber of the eye, or else to thrust the iris forward by its accumulation in the posterior chamber of the aqueous humour. If the inflammation proceed, this may become organized, and present a permanent obstacle to the transmission of light, or the capsules of the lens may be thickened and rendered so opaque that the patient may become temporarily or irrecoverably blind. The disease may proceed to still further destruction of parts, but in general it is early subdued by medicine, when it usually terminates by resolution, and before any irremediable alteration of structure has taken place. In this case the red vessels disappear, the effused lymph is absorbed, and the adhesions being recent and slight are readily broken down, and the patient ultimately recovers the perfect use of the organ. But its powers are often for a time impaired, so that vision is either confused or weak; neither does the pigment of the eye immediately resume its colour, but is so changed that a hazel eye is turned to grey, and a black eye to a green one, and the patient after his recovery has perhaps one eye of one colour and the other eye of another colour, and neither of them the natural colour—an unsightliness which may last for a considerable time.

Inflammation of the cornea or of the conjunctiva is rarely accompanied by severe pain, but more commonly by soreness; a sensation of dryness; great weakness of sight, and by an increased lachrymal discharge. Iritis, on the contrary, is usually attended by severe, agonizing, deep-seated pain, and by intolerance of light. There are, however, a few instances in which the pain is trifling, and the sight merely weak. Syphilitic Ophthalmia is in general double, but in a few instances is limited to one eye. The duration of the various forms is usually short, as they readily yield to a mercurial treatment. In general, iritis is preceded by one or more of the secondary symptoms, and most commonly is that affection which terminates the disease. It is said to be more frequent in women than in men, but this proposition is not established.

Treatment.—The cure of the primary ulcer has never been esteemed one of the great difficulties in the treatment of syphilis, for at all times, it has been observed often to yield to very trifling remedies; very generally to greater or less doses of mercury, and only in a few instances assuming an intractable or phagedenic form. In practice, however, this problem has been rendered one of the most intricate in medicine, from the various theories which have been connected with it. Some, for example, have considered the primary ulcer to be at first a local disease, and that the poison which contaminates the constitution is secreted by it, and consequently that early cauterization would prevent the occurrence of all the secondary symptoms; others again have held that mercury was essential to the cure of the primary symptoms, for without it they would not heal, and therefore that the system must to a certain extent be saturated with that metal; while others, again, have affirmed that medicine not only to be a remedy for the primary form of the disease, but also a specific antidote against the poison of syphilis, so that a given quantity was an infallible prophylactic against all the secondary symptoms, as well as a cure for them in every stage. These hypotheses, however, are altogether unsound, or in contradiction to all we know of the laws of morbid poisons—for mercury has been often proved not to be essential to the cure of the primary symptoms; neither is the poison secreted by the primary sore that which contaminates the constitution, so that cauterization will not cure the disease. Again, mercury is not a prophylactic against the secondary symptoms, for no quantity, however large, will prevent their recurrence, although it must be admitted that that medicine is often a remedy of great value in their cure. It follows then, from these considerations, that the rule of treatment in syphilis is to heal the primary sore as rapidly as possible, and to employ for that purpose the simplest and least injurious means in our power; and in this manner we effect not only the greatest present good, but also afford the patient the greatest number of chances of escape from an attack of the secondary symptoms. Again, should any secondary symptoms arise, we should treat it on the same simple principles as the surest prophylactic against any further number of the series; and consequently we thus greatly mitigate the sufferings of the patient, as well as shorten the whole duration of the disease.

Applying these principles, we find that a large proportion of the *unindurated* primary sores treated in the army, have been healed without mercury, except perhaps some mercurial wash or local application; and principally by confining the patient to his bed, or else to the wards of the hospital; and also to a spoon diet. The remedies employed in addition have been extremely simple, or occasionally general bleedings (as in six or eight cases out of 1940), purgatives, antimonials, emollients, soothing applications, generally cold or warm water mixed with the liquor plumbi; and in the latter stages by the application to the part of the lotio hydrargyri submuriatis or muriatis in aqua calcis, or else the lotio cupri sulphatis vel argenti nitratis, or other similar means.

In civil life, the same results have been obtained where the same means have been employed; but it is rare that the time necessary for the cure to take place can be commanded, and most writers recommend that the unindurated sore should be treated at first as a simple ulceration, or by cleanliness, by abstinence, and by applying to it the most mild and simple dressings; and many ulcers that will be followed by secondary symptoms will heal under this simple treatment. If the ulcer does not put on a healing appearance after a reasonable time, the patient should make use of more active dressings, as

Elementary Principles of Medicine.

the black wash; and should these be ineffectual, and the sore still remain open, a mild and judicious administration of mercury should be had recourse to till the sore is healed. In most cases, the pil. hydrargyri, gr. v. twice or thrice a day, is sufficient, and the success of Mr. Abernethy has proved that a large majority of primary ulcers will heal under this treatment.

In addition to the above remedies many practitioners recommend the application of lunar caustic to the sore, whatever may be the stage of the disease, as a means by which the process of cicatrization is greatly assisted. Mr. Carmichael, however, limits the time to the first stage, and before pus has formed. Ricord also tells us to abstain from using caustic to the part while it is yet granulating, and to confine its employment to points still in a state of ulceration—discrepancies which show that the practice is anything but determined.

The superficial venereal ulcer or excoriation "is the most easily cured by any mild astringent lotion injected five or six times daily between the glans and the prepuce, or the yellow mercurial lotion, or the weak solution of lead, or of the sulphate of zinc."

The indurated ulcer, like every other form of primary syphilis, has been successfully treated without mercury.

But it does not by any means follow that the non-mercurial is the most judicious mode of treatment. Indeed, almost all British writers are agreed that recovery under that method has been remarkably slow, while, if mercury has been exhibited, the healing of the sore has been certain and rapid. Ricord also states, that although the exhibition of mercury for unindurated ulcer is often more hurtful than beneficial, yet the circumstance of induration immediately transforms it into a therapeutic means of great power. In the treatment of the Hunterian sore, therefore, nothing is doubtful or perplexing; the rule being by mercury, and the exceptions only those cases where its use is forbidden by a debilitated or scrofulous diathesis, or by other peculiarity of constitution. The manner of introducing mercury into the system must be left in a great measure to the discretion of the practitioner. If the case be slight, five grains of the pilulæ hydrargyri twice or thrice a day is sufficient. It is more common, perhaps, wheu the case is well marked, to rub in half a drachm or a drachm of strong mercurial ointment every night, and this quantity is generally sufficient to touch the mouth in six or eight days, and to produce a considerable soreness at the end of twelve days; and shortly afterwards the ulcer heals.

When the ulcer has cicatrized, and the tissues which have been its seat have recovered their healthy state, the disease is cured. Sometimes, however, an induration remains, and in this case the cicatrix often ruptures, and relapses are the consequence. Under these circumstances, we should be cautious not to lay aside the use of the ointment too soon, and the patient should rub the part twice a day with mercurial or iodine ointment; a practice often successful when the indurated portion is situated on the skin, but not so commonly when on the mucous membrane. Delpech and many other surgeons have recommended excision, and this operation has succeeded, but more commonly has been followed by a renewal of the disease, so that it ought not to be employed except when the cicatrix is small, or of a cartilaginous hardness, and moveable in the subjacent cellular tissue. The resolution of this induration is, however, always tedious.

With respect to local treatment in the indurated ulcer, Beaumés states that it is not so advantageous as in the unindurated ulcer, and is favourable in proportion as the induration is dissipated by a mercurial treatment. All are agreed that fatty substances are ordinarily hurtful in the treatment of the indurated primary sore, and especially mercurial ointments. Many authorities also recommend cauterization in this form of ulcer, but this practice cannot be received as universal; and Ricord admits when the induration is even of little extent, cauterization is much less efficacious than under other circumstances.

Treatment of Venerola Phagedenica.—Ricord divides this description of ulcer into three kinds, or the indurated phagedenic ulcer, the phagedenic gangrenous ulcer from excess of inflammation, and the phagedenic gangrenous ulcer from debility or constitutional tendency.

The induration of a venereal sore or part may so increase as not only to oppose the formation of a cicatrix, but also to make such compression as to produce gangrene. In this form of the disease he recommends a concentrated solution of opium, emollient cataplasms, and antiphlogistic remedies. When the ulcer is of little extent, cauterization with the argentum nitratum, though not greatly successful, is still useful, and often stops the progress of the gangrene and represses those exuberant vegetations that have a tendency to become fungoid, and, much as mercury is hurtful in the other forms, by so much the more it is advantageous in this.

In the treatment of the gangrenous sore by excess of inflammation, he tells us we must forget the specific nature of the malady, and treat it merely with reference to this excess of inflammation. How many accidents, says this eminent authority, have we not seen from an empirical mercurial treatment directed against the specific cause! Dr. Collis also states, that throwing in mercury largely and suddenly was, in many cases, not successful.

The *Phagedenic Gangrenous Ulcer* from debility or constitutional idiosyncrasy is a form of disease most usually contracted in hot climates, and makes such havoc when the patient returns to the north, and is termed the "black lion." It is also sometimes contracted by persons living in low and damp situations, and is often suddenly and happily changed by transferring the patient to the wards of a well ventilated and well situated hospital. "In this form of gangrene," says Ricord, "it is a very great error to fly to the use of mercury. I can affirm, with very few exceptions, that nothing can be worse than mercurial dressings and mercury exhibited in this form of disease;" and he recommends repeated cauterization and an application of aromatic wine; and in severe cases, he sprinkles the part with powdered lytta and the "*pâte de Vienne*," which daily experience, he adds, authorizes him to recommend.

Treatment of Phymosis and of Paraphymosis.—Phymosis and paraphymosis are much less frequent attendants on indurated than upon unindurated sores; but whenever a disposition to phymosis or paraphymosis occurs, the patient should be strictly confined to the recumbent position, and in the former case be desired to inject warm water frequently between the glans and the prepuce. Poultices of bread and water may also be applied with advantage, and antimony given in such doses as may excite slight nausea. These means are often sufficient, but when the inflammation is violent, the penis considerably swollen, and attended with acute

pain, if the most active measures are not adopted, the inflamed parts will fall into a state of mortification. "In these cases," says Mr. Carmichael, "the symptomatic fever may run so high that the pulse is from 110 to 130, with thirst and restlessness; under such circumstances I immediately direct blood to be taken from the arm in proportion to the urgency of the symptoms and health of the patient, and repeat venesection every six to eight hours until the inflammation begins to yield. It is as necessary to have recourse to the lancet in these cases as in pleurisy or the most acute ophthalmia. However beneficial *local blood-letting* may be in inflammation of other parts, it is scarcely admissible in this; for if the matter which flows from beneath the prepuce should come in contact with the wounds, troublesome sores might follow, which might still further add to the inflammation it was intended to subdue. By active measures of this kind, if employed in time, we shall avert the worst result, a mortification of the prepuce, or suppuration of the body of the penis under its investing ligaments." In the phagedenic form of this affection the danger is imminent, and the best surgical advice should be had recourse to, and the division of the prepuce, if recommended, be immediately submitted to. In the

Treatment of enlarged inguinal glands, termed "Syphilitic Bubo," Mr. Carmichael has not found from experience that mercurial frictions will discuss them. On the contrary, the trials he has made incline him to believe that this medicine rather tends to increase their inflammation and consequently their tendency to suppurate. The application, however, of leeches and cold lotions, with attention to rest and quietness, he says, will often succeed in discussing them. When the bubo is hard and indolent, showing neither a disposition to disperse or to suppurate, he recommends the application of blisters to the indurated bubo, which soon either causes the dispersion or the suppuration of the tumor, and thus frees the patient from a troublesome symptom which might otherwise continue many months to torment him. If suppuration takes place, and the syphilitic bubo has broken, and the sore has a callous feel, and is either of a dark foul appearance, or of a light brown tawny colour, and this ulcer spreads, he says we may, with confidence, have recourse to mercury; and we shall in most instances find that quick amendment follows its exhibition. In general, also, after matter has formed, small doses of pil. hydrargyri have been found useful. The iodide of potassium has been strongly recommended in all forms of bubo by many foreign writers, but that medicine has not supported in this country the reputation it has acquired on the continent for the cure of that affection.

Treatment of the Secondary Symptoms.

If the problem of the treatment of the primary symptoms be difficult, that of the treatment of the secondary symptoms is still more so; for it is a law of morbid poisons that their secondary affections do not necessarily yield to the same remedies as their primary phenomena. It is plain, therefore, that mercury, the great agent in the cure of the primary symptoms of syphilis, is not necessarily efficacious in the cure of the secondary symptoms. In the treatment, therefore, of the secondary symptoms the early practitioners exhausted the whole pharmacopœia; and the modern French still employ a vast variety of remedies, so much so that Jourdan has dedicated a whole volume to their consideration; and even the formulæ of Desruelles, one of the last published works on syphilis, embrace no less than sixteen pages. The English school of medicine, however, has not been able to discover the beneficial effects of any other medicines in the cure of these forms of the disease than mercury, sarsaparilla, and, very recently, the iodide of potassium; the latter remedy, according to Drs. Watson, Clendenning, and others, having been first recommended for the treatment of this class of disease by Dr. Williams, of St. Thomas's Hospital.

Treatment of the Syphilitic Diseases of the Skin.—When the syphilitic poison falls on the skin, the many different diseases it excites require many different remedies and modes of treatment. In the course, then, of this class of affections we are obliged to employ all the three agents that have been mentioned, or mercury, sarsaparilla, and the iodide of potassium; and even these are not, in all cases, efficient.

Of all the syphilitic papular eruptions, the *lichen syphiliticus simplex* is the most intractable by medicine. The iodide of potassium does not appear to influence this form of disease, and when treated by mercury or by sarsaparilla either separately or together, it often continues many months. The liquor hydrargyri oxymuriatis, applied as a lotion night and morning, produces a much more decided effect, and without affecting the general health of the patient.

The *lichen syphiliticus agrior*, or that form of lichen which has a tendency to ulcerate, is much more amenable to medicine, and readily yields to a course of blue pill, but is little influenced by the iodide of potassium.

The *prurigo syphilitica* is said by Rayer to require cinnabar fumigations; probably sarsaparilla is a more efficient remedy.

Of the squamous eruptions, *lepra syphilitica* is almost as intractable as the lepra vulgaris, and only occasionally yields to the internal uses of sarsaparilla or of mercury, or of both conjoined. The liquor hydrargyri oxymuriatis, used as a lotion, however, greatly facilitates the cure.

The forms of *psoriasis syphilitica* are efficiently treated by dressing the part with the unguent. hydrargyri nitrico-oxydi. If combined with diseased bones, the iodide of potassium must be exhibited also.

The treatment of the *exanthemata syphilitica* is extremely simple. The *roseola syphilitica febrilis* readily yields in about a week or ten days to saline medicines, attention to the bowels, and a milk diet.

The *roseola syphilitica annularis* usually rapidly declines when treated by the iodide of potassium; but if the disease be neglected, a copper colour for a long time marks the spots which have been the seat of the eruption.

The *purpura syphilitica* sometimes yields to mercury or to the iodide of potassium; occasionally, however, these cases are most rebellious to every remedy, antisyphilitic or otherwise. One case which had resisted mercury, the iodide of potassium, and sarsaparilla, at last gave way to a treatment of five grains of iodic acid three times a day.

Of the *pustular forms of the cutaneous diseases.*—Ecthyma syphilitica having the phlyzaceous pustule often yields to sarsaparilla, but appears aggravated by mercury. A case of this form of corona veneris was treated with remarkable success by the iodide of potassium grs. viij. ter die, the sore being dressed with the unguentum hydrargyri nitrico-oxydi.

The only form of *vesicular* eruption in syphilis is *rupia*, a disease which requires much judgment in its treatment. The other cutaneous affections little impair the general health of the patient, but the tendency of this disease is so debilitating as rapidly to reduce the powers of the strongest man. Mercury in any form or quantity, exhibited internally or introduced by inunction, is highly dangerous and improper. Many cases treated even by small doses of mercury have terminated fatally, and large doses have been still more unsuccessful. There is one mode of treatment, however, which appears uniformly to succeed, or by dressing the sores with the unguentum hydrargyri nitrico-oxydi, and by supporting the patient either by sarsaparilla or the iodide of potassium, and the latter medicine is infinitely more beneficial than the former. But neither the sarsaparilla nor the iodide of potassinm, although singularly successful in restoring the health of the patient, possess the property of healing the rupial sore. The practice, therefore, is first to remove the scab or crust by a poultice, and then to dress the sore with the unguentum hydrargyri nitrico-oxydi, and at the same to give the iodide of potash in eight-grain doses three times a day out of camphor mixture; and the combined effects of this treatment in curing this disease is quite remarkable. If sarsaparilla be prescribed, the patient must, in addition, be supported by wine or porter, or both.

The *Tubercular Syphilitic eruptions* readily yield to small doses of mercury, or to the iodide of potassium, but more certainly to the former. The broad tubercular eruption, or *tubercula syphilitica plana*, is often intractable, especially when it ulcerates. In these cases an ointment of the iodide of potassium, a drachm to the ounce, or the unguentum hydrargyri nitrico-oxydi, are useful applications; but under every mode of treatment the cure is long and protracted.

The *herpes preputialis* yields to any slight astringent lotion, as, a solution of half a grain of acetate of lead to an ounce of water, or to an application of zinc ointment.

For the cure of the cutaneous excrescences or growths, the remedies are almost as endless as the forms of disease. They may be removed by the knife, ligature, or by cauterization, or they may be destroyed by savin powder, by the liquor plumbi acetatis, by the tinct. ferri muriatis, the liquor hydrargyri oxymuriatis, or by acetic acid. The iodide of potassium and mercury, by inunction, have also been found useful in dispersing these adventitious growths. Ricord recommends sprinkling the parts with calomel, having first washed them with the chloruret of soda. Under every mode of treatment, however, these growths have a great tendency to return.

Treatment of the Syphilitic affections of the bones.—The treatment of the syphilitic affection of the bones and of the periosteum has hitherto been the "questio vexata" of syphilis. Some pathologists have contended that this class of disease will heal under a simple antiphlogistic treatment, but there is no sufficient evidence of this result, for long intervals have frequently elapsed, especially in seamen, from the first commencement of the affection before any medical treatment has been employed, yet without any mitigation or appearance of subsidence of the symptoms. The affections of the bones of the nose and of the palate are seldom painful, and the applications for advice in these cases are often long delayed. But the longer the delay the more aggravated and serious the disease, and the greater the chances of disfiguration and of exfoliation. It must be concluded, therefore, that without the aid of medicine the number of victims from this class of disease would be distressingly large, and their sufferings indescribably severe. Happily, however, we are provided with efficient remedies against these great evils in mercury, sarsaparilla, and more especially the iodide of potassium; and it will be seen that all these remedies are necessary in the cure of diseases of the bones.

In the cure of the hard periosteal node the properties of sarsaparilla are so doubtful that its exhibition in these cases is generally abandoned as inefficient or useless. It is admitted, however, that many cases of hard nodes will yield to mercury when given in such doses as to affect the system. Still there are many others in which this metal produces no such successful result, for although the patient is generally relieved as soon as ptyalism is established, yet the pathological state of the parts often remains unchanged; so that on the salivary discharge ceasing the pain returns, and the patient is doomed to many years' excessive suffering, or is only relieved during the time that he is under the fullest influence of mercury. It is painful even to reflect on the ceaseless agony under which these patients have often been seen to suffer. "Pain," says Mr. Carmichael, "is a mild term to express their tortures." It is impossible to determine with any accuracy the number of cases in which mercury is inefficient, but it must be large. Ricord states, "that mercury, only occasionally useful in the primary affection, is incontestably so in the secondary affections, as those of the skin, and again loses its curative properties in the tertiary accidents, or those of the bones." This, perhaps, is in excess, but there is no good writer on syphilis, from Ambroise Paré to Desruelles, who has not proposed cutting down on the intractable node, and destroying it either by actual cautery or by the hammer and chisel. A more efficient treatment of this affection was necessary, and the discovery of the virtues of the iodide of potassium as its surest antidote forms an epoch in the treatment of syphilis.

Indeed it appears to be clearly and irrefragably demonstrated that this salt is the great specific remedy in the cure of this form of secondary syphilis. Nor can the action of quina be considered more certain or more striking in the cure of ague than that of the iodide of potassium in the cure of the hard syphilitic node. Its effects in some hundreds of cases have been, with one exception, to remove the pain in a very few days; and, if the node be recent and the parts not extensively disorganized, to permanently cure the patient. It is only in the old chronic node, and when extensive morbid growths have formed, and such as we may now reasonably hope never to witness again, that the iodide of potassium has failed in effecting a permanent cure. In these cases of confirmed disease mercury is equally inefficient as a curative remedy, and never affords the relief that the patient in every instance receives from the iodide of potassium, and which generally lasts for a considerable time.

On comparing this new mode of treatment with that by mercury it has these advantages:—The relief from pain by mercury is seldom complete till the mouth is fully affected, while under the use of the iodide of potassium the patient is usually free from pain in three or four days, and almost constantly so within a week. Again, mercury often appears to aggravate the disease,

and always impairs the constitution. On the contrary, the iodide of potassium has in all instances alleviated the disease, and the rapidity with which this class of patients increase in flesh and in strength is quite remarkable. The iodide of potassium also is useful in a much larger number of cases, and effects the cure without that train of disgusting circumstances which accompanies ptyalism, or that enlargement of the cervical glands, so common when mercury is used. The absorption also of the morbid growth is more certain, and the frequency of relapse diminished, while the cure is obtained in a much shorter time, and consequently at much less expense to the patient both of his constitution and of his purse. On all these grounds, therefore, the iodide of potassium must be considered as infinitely superior to mercury in the cure of this once formidable disease.

The iodide of potassium has been given in doses of 15, 20, and even 30 or more grains; but this is in excess, and generally produces headache, vomiting, and purging. Some constitutions, on the contrary, are offended even by one or two grains. The average dose, therefore, of the iodide of potassium has been found to be eight grains three times a day, and even this often causes three or four motions in the 24 hours. A smaller dose can hardly be recommended, for the patient's sufferings require immediate relief, and consequently we ought to begin with as large a dose as his stomach will probably bear. Eight grains, then, is the mean dose for an adult, and as it usually gives relief in three or four days it is plainly efficient. Some practitioners are in the habit of adding half a grain to a grain of pure iodine to the iodide of potassium; but supposing iodine to act in proportion to the quantity absorbed, and not by its mere acridity, this is a great medical error, for it disorders the stomach without in any sensible degree benefiting the complaint. It is determined, for example, that the iodide of potassium contains three-fourths of its weight of pure iodine; so that a patient taking 28 grains of the former in the course of 24 hours takes no less than 21 grains of the metal. The addition then of half a grain to a grain in the 24 hours of pure iodine is so trifling that it may be neglected; while its acridity is so great that Mr. Stone, of Christ's Hospital, formerly assistant apothecary at St. Thomas's Hospital, states, he used to be called to prescribe for 10 patients taking the compound of iodine and of the iodide of potassium for one that was taking the latter medicine only.

The modes of action of iodine cannot of course be ascertained; but it is absorbed, and perhaps has an affinity for the syphilitic poison, which it modifies, and deprives of a part of its power to inflict disease. Metallic iodine is supposed to be taken up by the absorbents, as hydriodic acid, the metal combining with the hydrogen of the fluids of the stomach. The iodide of potassium is probably absorbed in substance, and so rapidly, that iodine may be often detected in the urine within ten minutes after the patient has swallowed it. It is also found in the saliva, in the tears, in the milk, and probably in the other secretions of the body; but it has not been satisfactorily demonstrated in the blood, being either so rapidly removed as to exist only in quantities too minute for detection, or else resolved perhaps into its elements. The time that it may be detected in the urine, after it has ceased to be exhibited, is not yet determined; but in two cases no trace remained after forty-eight hours. It is remarkable that iodic acid, though a solid substance, is not detected in the urine, even after being exhibited in doses of six or eight grains, three times a day, for a considerable length of time, pointing either to a singular relative affinity of the lacteals for different medicinal substances, or supposing the substance to be absorbed, that it must be removed by some other organ or tissue than the kidneys. The iodic acid has likewise no similar property of curing the syphilitic node with the iodide of potassium. The best means of detecting the iodide of potassium in the urine, is first to add a solution of starch, and then a small quantity of a solution of chlorine. This latter agent immediately setting free the iodine, which combines with the starch, and produces the usual beautiful violet or indigo tint.

The quantity of iodide of potassium necessary for the cure of the hard node is probably in proportion to the pathological state of the part. Some patients, freed from their pains, ask to be dismissed at the end of a week, or before an ounce can have been taken. In general, perhaps, a month is about the average time of treatment, and the quantity used varies from four to six ounces; but when mercury has been previously and unsuccessfully employed, the quantity has sometimes exceeded a pound. It is singular that the hard node, although it is often permanent on the lower extremities, is almost always absorbed when seated on the upper extremity.

The hard node sometimes suppurates, and this form of periostitis was formerly frequent. This change in the pathological state of the parts requires a different treatment, and demonstrates the truth of the remarkable law, that when inflammation terminates in abscess, the remedy which, timely administered, would have prevented so untoward an event, now loses all its power over the disease, and even aggravates the symptoms. As soon, therefore, as the node runs into suppuration, mercury ceases to be in any degree beneficial, while sarsaparilla seems to be the specific remedy. It is probable, however, that the iodide of potassium also will heal, or beneficially influence, this state of the node; at least the iodide of potassium greatly relieves the pain, and apparently accelerates the healing of the part.

The *hard cranial node*, although having the same external characters as the hard node on the long bones, it has been shown, has an entirely different structure, and consequently some doubt might be entertained whether the same medicinal agents would be found equally beneficial in this class of cases. Experience, however, has shown that they have exactly the same powers. Mercury often removes them, but they often suppurate, and have a great tendency to relapse under that treatment. The iodide of potassium, however, gives more certain and quick relief, more readily occasions absorption, prevents ulceration, and in fact cures the disease. When the node has suppurated, either sarsaparilla or the iodide of potash will heal it; but the two remedies combined are perhaps the most efficacious. Again, should the node have ulcerated, the iodide of potash, either *per se* or aided by the ung. hydr. nitr. oxydi, effects, even in this state, the cure.

Syphilitic inflammation of the *substance* of the long bones may exist *per se*, or may co-exist with the hard periosteal node. It has no diagnostic symptoms by which it can be distinguished from the hard node, except perhaps that the bone is more generally enlarged, the pain greater, and the disease more intractable. As

Elementary Principles of Medicine.

long as the inflammation is limited to the superficies of the bone, or to some portion of the cancellous structure, or merely causes some modification of the medullary matter, it probably yields either to mercury or to the iodide of potassium. When, however, an abscess forms in its substance, exfoliation must of necessity take place; all specific remedies lose their power, and opium is the only mode of procuring relief. As soon, however, as the diseased portion of the bone is detached, sarsaparilla appears to facilitate the formation of granulations, and under its use the part heals.

The *soft gelatiniform* or *gummy* node is a disease of much less frequent occurrence than the hard, or even the suppurating node, and is indeed but rarely seen. These nodes are rarely cured by general treatment, or by mercury, or by sarsaparilla. Neither does the iodide of potassium satisfactorily influence them. Cullerier has proposed, while they are yet incipient, to attack them by blisters or a caustic solution, and states he has often succeeded. Ricord also praises this mode of treatment. One patient who had lost the use of his right arm from pressure on the nerve by one of these tumors, whom every treatment was unsuccessful, mentioned that his sister had been operated on for a node similarly situated, and that she had died.

When the syphilitic poison has fallen on the bones of the nose, palate, or face, neither mercury nor sarsaparilla, though continued for many weeks, have appeared to interrupt the course of the disease, or to prevent exfoliation. Still, in quite the incipient stage, the iodide of potassium has often fixed the loosened bones and cured the patient. As a general rule, however, in the advanced stages, this medicine, although it improves the general health, has no power over the affected part, and it is necessary to combine with it a local treatment. When the bones of the nose, therefore, are affected, the iodide of potassium should be exhibited in the usual manner; but at the same time the black wash should be injected twice or thrice a day up the nostrils; or, what is better, the interior of the nose should be anointed with the unguentum hydrargyri nitrico-oxydi, as far as the probe can reach. This latter mode of treatment is uniformly successful, and always saves the nose, and consequently the patient from being disfigured. When the bones of the palate are affected the general and local treatment are the same, but the unguentum hydrargyri nitrico-oxydi should be applied more cautiously to the ulcerated part, on account of its being readily removable by the tongue.

Treatment of Syphilitic Angina.—The treatment of mild cases of syphilitic angina, whether the tonsils be or be not swollen, is by moderate doses of mercury, as of the pilulæ hydrargyri gr. v. bis vel ter die, or even by sarsaparilla. But in severe cases these remedies, however judiciously administered, will not cure the disease, but, on the contrary, often aggravate it; and it is essential that the attention of the student should be drawn to the value of local remedies in this affection. The treatment of these severe cases is to prescribe eight grains of the iodide of potassium ter die, which, without having any power to heal the throat, will greatly support the strength and improve the health of the patient, and in addition to this the ulcerated portions, as far as they can be reached, should be touched night and morning with the unguentum hydrargyri nitrico-oxydi, and under this treatment the ulcers readily granulate, and the throat rapidly heals.

Not only will the deep-eating ulcer heal under this local treatment, but also the superficial and intractable serpiginous ulcer, and the number of cases successfully treated in this manner is now very large, and quite sufficient to establish the great value of this practice. The best mode of applying the ointment is by a piece of lint, attached to the end of a pencil. As a general principle it is seldom that mercury, applied in this manner, affects the mouth; but in two or three instances it has had that effect, and in each instance there was an immediate extension of the pharyngeal ulceration, showing that the amelioration is occasioned by the local stimulus, and not from any constitutional affection of the system.

Treatment of Syphilitic Ophthalmia.—The cure of syphilitic ophthalmia, whether the inflammation affects the conjunctiva, the iris, the cornea, or all of these parts, is by mercury, which is the great specific and only remedy in these cases, for neither sarsaparilla nor the iodide of potassium appear to have the slightest influence in controlling the disease. In every case therefore of *acute* syphilitic ophthalmia mercury should be given in such quantity as to ensure the patient's mouth being affected in a few days. For this purpose, two grains of calomel twice or thrice a day, or five grains of calomel every night, are in general sufficient. Some authorities prefer the proto-ioduret of mercury to calomel, yet it seems unimportant by what means salivation is produced. When the mouth is affected the pains and inflammation in general subside. In a few cases, however, a considerable chronic conjunctivitis remains, which is best treated by the unguentum hydrargyri nitrico-oxydi, applied locally to the eye.

Many writers recommend, in addition to mercury, that blood-letting, both locally and generally, should be had recourse to, and that to a large amount. But this practice appears altogether unnecessary, and must in many cases be highly injurious by favouring the action of the poison on a debilitated system. Blisters have also been recommended, and are occasionally of service, but are seldom essentially necessary. The circumference of the orbit, and also the mucous membrane of the nose, is, by many practitioners, smeared with belladonna ointment; but there is seldom any necessity even for this application.

When the syphilitic ophthalmia is *chronic*, an alterative mode of treatment is often sufficient. A gentleman whose sight was considerably impaired by the deposition of a considerable quantity of lymph on the cornea, was directed to take five grains of the pilulæ hydrargyri every night; and under this treatment the nebulæ in a few days disappeared, although the constitution was not in the slightest degree affected.

Treatment of syphilitic affections of the joints.—When the poison falls on the ligaments and synovial membranes, these diseases are in most cases obstinate of cure; but, as a general principle, the affections of the elbow-joints readily yield to the iodide of potassium. Of the other joints it is difficult to determine whether they yield more readily to small doses of mercury, or to the iodide of potassium. The latter, however, should first be tried. One gentleman who has paid much attention to the effects of the iodide of potassium in these cases, says, "Respecting the treatment of the affections of the ligaments, with considerable swelling of the joints, very much resembling rheumatism, the iodide of potassium is an invaluable remedy. It produces good nights, reduces the swelling, and promotes the general health."

In the foul wards the patient often asks for it, and it is frequently successful.

Dietetic Treatment.—Mr. Hunter taught, that "the manner of living under a mercurial course need not be altered from the common;" but it has been found that a dietetic treatment so much overlooked by Mr. Hunter greatly influences the cure, and that the healing of the primary sore by the unaided efforts of nature is hardly to be obtained except by adopting an exceedingly severe regimen, or the "cura famis." The influence of a dietetic treatment is, therefore, strongly marked in the case of syphilis.

The "cura famis," as the term implies, consists in limiting the patient to an extremely low diet, to confining him to the house, and also to using some trifling local application. Desruelles says he found that the mean duration of a number of cases of primary sore, treated by the "cura famis," limited to a vegetable diet, was thirty days; while a similar number of cases, treated on the same plan, but allowed animal food, was fifty days. He found also a similar difference when mercury was used; for the mean duration of a limited number of cases treated by mercury, and limited to a vegetable diet, was forty-four days, while when animal food was allowed it was fifty-six days. Ricord agrees with Desruelles, that, as a general principle, animal food ought to be avoided in the cure of primary syphilis; but adds, that in feeble constitutions he has often seen the worst consequences from its adoption, and that it is, consequently, often necessary to give the patient the support of an abundant and liberal diet.

In the cure of the secondary symptoms, the patients are generally impatient when limited to a milk or vegetable diet, and perhaps iritis is the only disease in which a forbearance from animal food is absolutely necessary. In rupia, in sloughing sore throat, and when the patient is broken down by severe affections of the bones, a full diet of animal food, with a liberal allowance of wine and porter, appear greatly to facilitate the patient's recovery. In very severe cases, it should be added, there is no greater restorative than change of air.

Preventative Treatment.—When a party has been exposed to infection, there is no other preventative remedy than extreme cleanliness. The chlorides have been recommended, but they probably have no power to neutralize the poison. Still, supposing them to possess such a property, yet the application of these, or of the bichloride of mercury, or of any other substance, must, under any circumstances, be too late to prevent the absorption of the poison, and, consequently, the contamination of the system.

Of the Poison of Gonorrhœa.

Gonorrhœa is a contagious disease, producing a specific suppurative inflammation of the mucous membrane of the urethra and glans in the male, and of the mucous membrane of the genital organs in the female. It occasionally also affects the mucous membranes of the eye, and of the rectum.

The history of the first appearance of gonorrhœa is extremely obscure, and in the absence of all evidence connecting this disease with the remoter periods of medicine, two hypotheses have been entertained—first, that it prevailed prior to the introduction of syphilis; and again, that it was first observed about half a century after the breaking out of that disease. The strongest and most conclusive arguments are supposed, however, to favour the first hypothesis.

Remote Cause.—The combination of causes which produced this poison in the human subject are entirely unknown. Many physicians have thought, with Ricord, that any acrid or irritating discharge in the female would cause this disease. "But how many men," says Beaumés, "know their wives, or other women, when affected with leucorrhœa so acrid as to excoriate the thighs of the parties, or even when labouring under the discharge of incipient cancer, without ever contracting gonorrhœa; yet if these same women become faithless, their husbands are immediately infected."

Whatever may be the source of this poison in its habits, it seems peculiar to man; for Mr. Hunter says, "I have repeatedly soaked lint in matter of gonorrhœa, and introduced it into the vagina of bitches, into the vagina of asses, and under the prepuce of dogs, without any effect. I have also made incisions under the skin, and it has only produced a common sore."

Predisposing Causes.—In general the more feeble the health of the party, the greater the susceptibility, and the longer the duration, of the disease.

It appears *climate* has an influence in the occurrence of gonorrhœa; for, by the returns of the British army, that disease is much more frequent among the troops stationed in this country than in the Mediterranean and the West Indies. The infrequency of gonorrhœa among the inhabitants of warmer climates is owing, perhaps, to the practice of more frequent ablution, and, consequently, to greater cleanliness. According to the records of the Hôpital de Vénériens, at Paris, this disease is greatly more frequent in spring and autumn than at any other seasons of the year, perhaps owing to the holding of a greater number of fairs and festivals at those periods.

Contagious.—The evidence of the contagious nature of this disease is of the strongest description—namely, the constant contamination of a healthy person having intercourse with a diseased one. In a very few instances, the contagious nature of this disease has been proved by a voluntary application of the poison to the urethra in the male, for the purpose of settling this disputed question.

Fomites.—The possibility of this disease being communicated by inoculation is a sufficient proof of this fact; but the transmission by fomites is extremely rare.

Susceptibility not exhausted.—It is probable that the susceptibility to the poison of gonorrhœa is never entirely exhausted, although it has many degrees. The most general maxim is, that the first gonorrhœa is the most severe, and the succeeding ones become milder and milder, till in some cases the danger of infection almost vanishes.

Co-exists.—The poison of gonorrhœa is capable of co-existing with many other poisons. It occasionally happens that the discharge becomes most profuse in the latter stages of typhus fever, while in the earlier ones it may stop altogether. It frequently also co-exists with erysipelas, and probably with every other disease known to depend on a morbid poison.

Modes of Absorption.—This poison is absorbed by all the mucous membranes it is usually brought in contact with; and, reasoning from all analogy, must infect the blood before it produces its specific action; and if we admit orchitis, and some cutaneous eruptions, to be

secondary actions of the poison, and not the mere effect of sympathy, this law appears satisfactorily proved.

Period of Latency.—The time which elapses after contamination before the discharge is established, varies considerably in different persons; but every period between six hours and six weeks has been mentioned as the period of latency. In general, however, it is from three to twelve days.

Pathology.—The theory of this disease, as deduced from analogy, is that the poison of gonorrhœa is absorbed by the mucous membranes, and infects the blood; and after a given period of latency, produces suppurative inflammation of the mucous membrane, to which it has been distinctly applied, whether of the urethra and glans in the male, the genital organs of the female, or of the rectum, nose, lip, or eye of either sex. It is probable that this poison has only one secondary action, or on the testicle, when it produces in a given number of cases orchitis. Many authors, however, have attributed a slight inflammation of the fauces, and also certain slight cutaneous eruptions, to this poison; but the proofs are at present insufficient to establish this doctrine. Bubo is probably the result of sympathy, and stricture of local inflammation.

The following are the parts in the male and in the female which it more commonly affects:—

Parts primarily affected in the Male.

Urethra	producing	Gonorrhœa.
Glans, Prepuce	,,	Gonorrhœa spuria.

Parts secondarily and accidentally affected in the male.

Testicle	producing	Orchitis.
Inguinal glands	,,	Bubo.
Tissues of the urethra	,,	Stricture.

Parts primarily affected in the female.

Vulva, Vagina, Urethra	separate or combined	producing Gonorrhœa.

Parts secondarily and accidentally affected in the female.

Inguinal glands	producing	Bubo.
Uterus	,,	Uteritis.

The discharge resulting from the inflammation is in either sex a white, yellowish, or greenish pus, according to the state of health of the patient and the duration of the disease, and is sometimes mixed with blood. It is likewise alkaline, and possesses the other usual chemical properties of ordinary pus. It was formerly supposed to proceed in the male, from ulceration of the urethral membrane, but subsequent observation has shown as a general law, that gonorrhœa arises from a suppurative inflammation of the mucous membrane of the urethra, without breach of surface, and that ulceration occurs only in a few rare cases.

It is generally supposed that in gonorrhœa the inflammation of the mucous membrane of the urethra is partial, and Haller, Mr. Hunter, and others have limited its extent to the fossa navicularis, or the portions immediately under the glans. But Boyer and Cullerier consider that the redness found in the anterior portion of the urethra after death is caused solely by the part being pendent. The fact also that extensive suppurative inflammation often exists in mucous membranes, without any redness being discoverable after death, renders Mr. Hunter's opinion rather questionable, especially as the pain in the perinæum, and the formation of stricture commonly in the bulbous part, show that the remoter parts are oftener inflamed.

The inflammation of the mucous membrane of the urethra frequently extends to the surrounding tissues, or to the cells of the corpus spongiosum, so that they often become bound down by adhesive inflammation, and the phenomena of chordee are the consequence; small tumors also sometimes form in the course of the urethra, and which may suppurate and burst, either into the cavity of the urethra, or externally; and sometimes in both directions, so that a false passage is the consequence, and hence fistula in perinæo.

When gonorrhœa is chronic, the urethra is not unfrequently the seat of *stricture*. The formation of stricture is as follows. When the canals of the body, as the intestines or œsophagus, are inflamed, the affected part contracts, and while thus contracted they often become bound down, and thus their diameter is greatly diminished. According to Mr. Hunter, stricture of the urethra is seldom of greater breadth than if the part had been surrounded with a piece of pack-thread; but, occasionally, the urethra has been found contracted for more than an inch. A stricture may form in any part of the urethra, but the most common seat is about four and a half inches from the origin of the glans, and again at between six and seven inches, or just behind the bulb. They are usually slow in forming, and sometimes thirty to forty years have elapsed from the time of the patient suffering from gonorrhœa to the formation of a stricture.

The mucous membrane covering the strictured portion is sometimes natural in its appearance; at others a little thickened, and occasionally the surface is abraded and ulcerated. The two last effects are generally produced by attempts to pass an instrument, which sometimes causes false passages.

When the gonorrhœal inflammation is violent and long-continued, the prostate has become acutely inflamed, and has even suppurated.

A swelling of the testicle or orchitis is a frequent occurrence in gonorrhœa, but so few persons die of this affection, that its pathology is little known. The epididymis, the cord, and the vas deferens, however, are the parts first attacked, while the body of the testicle subsequently enlarges, and sometimes acquires a very considerable magnitude. If the disease continues, lymph or serum is thrown out, and from the latter cause hydrocele often occurs. The left testicle is more frequently affected than the right, and it is only occasionally and rarely that both are affected.

Another occasional effect of gonorrhœa is bubo, or inflammation of the inguinal glands, and which may terminate in induration with enlargement, or else in suppuration.

In the *female* the vagina is usually the principal seat of gonorrhœal inflammation, and some authors contend that it is confined to this part, but there are cases in which pressure on the meatus urinarius produces a flow of pus, the vagina being in no degree affected. These parts, therefore, may be either separately or conjointly affected. When the vagina and urethra are alone diseased, nothing is to be seen externally; but on separating the labia, we observe some inflamed points, which are the orifices of enlarged mucous glands. In severe cases, the parts both external and internal are

more or less swollen, and also the membrane enveloping the clitoris; and this inflammation sometimes extends to the neck of the uterus, causing exquisite pain. When the irritation is great, one or more small abscesses form occasionally in the cellular tissue of the labia.

In chronic gonorrhœa the appearance of the parts is often natural. Mr. Hunter states he had frequently examined patients who complained of the usual symptoms, as increased discharge, pain in making water, and soreness, and yet could perceive no difference between these parts and such as were quite healthy.

In the female, stricture of the urethra is extremely rare, but it is not uncommon to find caruncula or polypus in the interior, or at the orifice of the urethra, causing great pain, and often keeping up the discharge till their removal, either by excision or by cauterization.

According to Ricord, gonorrhœal ophthalmia always proceeds from the direct application of the matter of gonorrhœa to the eye, producing ophthalmia in the highest degree. As early as the first or second day, the conjunctiva, as well as the internal surface of the eyelids, as also the globe of the eye, is gorged and swollen, so as to form a considerable prominence, and give an appearance of the cornea being depressed; and this salient state of the conjunctiva is considered by Lagneau as almost peculiar to this form of ophthalmia, and its diagnostic symptom. From the first moment of attack light is painful, and the secretions of the eye resemble in every respect the yellow-greenish discharge of urethral gonorrhœa, and so acrid that it inflames those parts of the cheek and nose over which it flows. The eyelid now becomes swollen, and the tumefaction of the conjunctiva excessive. In bad cases, the cornea also becomes nebulous, or ulcerates, and procident staphyloma follows, so that the humours of the eye escape, and blindness is the inevitable consequence; a result which may take place in four or five days, and has been known to occur in twenty-four hours. In the majority of cases, however, the ophthalmia is chronic, and the patient recovers without any disorganization of the eye.

Symptoms.—Gonorrhœa may be acute or chronic; and in the male there are two varieties of this disease, or gonorrhœa and gonorrhœa spuria.

Acute gonorrhœa in the male is the discharge of a purulent matter from the urethra. Its first symptom is generally an itching about the orifice of the urethra, which some authors have described as not disagreeable; and this usually comes on about forty-eight hours after contamination. At the end of three or four days it becomes distressing, the lips of the urethra become red and swollen, and pain is now felt on passing the urine, which increases till it becomes so intense as to be termed scalding; the patient finds walking and riding difficult and painful. This inflammation extends also to the glans, which is swollen, tense, and according to Mr. Hunter resembles "a ripe cherry." The parts are now often sore, greatly distended, and at night often intolerably so; and frequently attended with *chordee*. Occasionally the inflammation extends to the prepuce, and causes phymosis or paraphymosis.

The discharge usually begins a few hours after the titillation or itching. It is first a semi-transparent fluid which glues up the orifice of the urethra, and then, about the sixth or eighth day, and often sooner, a puriform matter flows in considerable abundance from the urethra, and which may be white, yellow, green, or any other variation of colour or of consistency common to pus.

The inflammatory symptoms are usually at their height about the fourteenth day, and continue so till the twenty-fifth or thirtieth, when the pain diminishes; the parts become less irritated, and the discharge becoming less and less abundant at length disappears. Such is the usual course of gonorrhœa; it may, however, be much milder or much more severe. In general, gonorrhœa does not terminate till the thirtieth or fortieth day; but in a few instances it ceases in a few hours; while in others it is prolonged for many months. In the latter case it is termed a *gleet*. The matter of gleet is supposed to be non-contagious; but this doctrine is dangerous, and is probably the cause of frequent infection immediately after marriage.

When the disease is complicated with *bubo*, the inguinal glands are swollen, sore to the touch, and sometimes acutely painful, although they do not usually suppurate.

A swelling of the *testicle*, or *orchitis*, is frequent in gonorrhœa, and is calculated to occur in one of every three cases. This affection may take place at any stage of the disease, but is most common towards its decline, and usually coincides with a diminution or entire suppression of the gonorrhœal discharge. When the testicle inflames the patient suffers excessive pain in the part extending to the back, loins, and pelvis. The stomach and bowels also generally sympathize, and nausea and even vomiting are common symptoms. After being inflamed it is generally a long while before the swelling of the testicle entirely subsides, but by degrees it diminishes, and from being much harder becomes even softer than natural; and many years may elapse before the epididymis regains its natural texture.

The disease termed *gonorrhœa superficialis vel spuria* consists of an inflammation of the membrane covering the glans penis and inner surface of the prepuce, followed by a purulent discharge similar to that from the urethra. The glans and prepuce are commonly greatly swollen, red, and painful, and their surfaces are sometimes superficially ulcerated. In this latter case, the extensibility of the glans being much greater than that of the prepuce, phymosis or paraphymosis may take place, and, in some instances, the constriction has been so considerable as to produce gangrene and sloughing of the entire penis. When sloughing attacks the glans, it usually begins in the fossa or root of that part, or at the insertion of the prepuce.

When the *female* is affected with gonorrhœa the vagina is often alone attacked, and this part not being endowed with much sensibility, the pain is trifling. When, however, the disease extends to parts more painful than the vagina, as the inner surface of the labia, the nymphæ, clitoris, caruncula myrtiformis, and meatus urinarius, the parts are so sore and painful as not to bear to be touched; the patient can hardly walk, and great pain is experienced when the urine comes in contact with the inflamed surfaces. The parts affected are also often greatly swollen, so that we can hardly introduce the finger into the vagina; and the discharge is so acrid that it excoriates the parts over which it flows. In some cases the bladder sympathizes, and produces, as in men, the same irresistible desire to void urine, the same micturation, and sometimes the same retention. The inflammation also sometimes affects the mucous glands, producing hard swellings of the inner surface of

the labia, which occasionally suppurate and produce small abscesses in the vagina.

Women also very often labour under chronic gonorrhœa without any suffering, and consequently often communicate this disease without knowing that they are themselves diseased, and no more difficult question exists in medicine than to determine whether they are or are not affected. "The kind of matter," says Mr. Hunter, "gives no assistance in distinguishing gonorrhœa, for it often happens the discharge in fluor albus puts on all the appearances of the venereal matter, and an increase in the discharge is no better mark by which we can distinguish the one from the other. The appearance of the parts also gives us but little information; for I have frequently examined those who confessed all the symptoms, as an increase of discharge, pain in making water, soreness in walking, or when the parts were touched, yet I could see no difference between them and sound parts. I know," he adds, "of no other way of judging in these cases where there are no symptoms sensible to the person herself, but from the circumstances preceding the discharge, and the connexions she may be supposed to have had with other diseased persons."

Gonorrhœal ophthalmia is very marked in its symptoms, and is always accompanied with great pain and intolerance of light.

Treatment.—The treatment of gonorrhœa in the male is either by medicines which are supposed to have a specific action on the parts, or else by general treatment. In the former, the object is to cure the disease in a few hours: in the latter, the disease is allowed to run its course, which is commonly from five to six weeks, the practitioner only interfering to obviate symptoms.

Among the specific remedies is the balsam of copaiba. This medicine is considered to be a species of turpentine from which may be distilled a volatile oil, leaving a pure resin as a residue. The balsam, however, is supposed to be more efficacious, and to sit more easily on the stomach than either of its component parts. The dose, in the last pharmacopœia, is described as being from a scruple to a drachm; but the medicine has been employed in much larger doses both in this country and on the continent. Monteggia and Fuller have given from two to three drachms for a dose, while Ribes found, in consequence of a mistake made by a patient, that it might be given to the amount of one or two ounces; and he has prescribed it in this dose in every stage of gonorrhœa, and even when accompanied with swelled testicle, bubo, and gonorrhœal ophthalmia; and he gives many instances of swelled testicle cured by these large doses. Rossignol also states that he cured upwards of 300 cases in less than a week by one to two drachms a-day. These practitioners gave the balsam pure, or mixed with syrup, or mucilage, or yolk of eggs, or with powdered sugar, or else directed it to be taken swimming on the top of a glass of wine or of lemonade, or taken out of an effervescing draught.

This medicine, however, thus exhibited, often makes a most disagreeable impression on the stomach, so that, by many patients, it is constantly rejected. MM. Velpeau, Brettoneau, and Labat have, consequently, given it as an enema dissolved either in mucilage or yolk of egg in doses varying from ʒ j. to ℥ j. a day, and added to it laudanum to cause it to be retained. Velpeau found this method produce its best effects between the fourth and seventh day, and that, after the eighth or tenth day, it either entirely succeeded or entirely failed.

It has been proposed to render copaiba more palatable by solidifying it by gradually mixing with it $\frac{1}{16}$th of its weight of calcined magnesia; by which process, at the end of a fortnight, it acquires the consistency and transparency of gum, so that it can be made into pills; whereby much that is disagreeable both in its taste and odour is avoided. Copaiba, however, is so much the more efficacious as it is exhibited in a liquid state, that unless the vomiting or purging which it sometimes induces requires an adjuvant, it should be administered without combination; and, with this view, it has lately been enveloped in capsules, which have rendered it less distasteful, but perhaps not so entirely as has been generally imagined. When copaiba is given by the mouth, it should not be taken till three or four hours after eating, else it produces great disturbance of the digestive organs; and many patients therefore generally prefer taking this medicine night and morning. It is singular that persons who take copaiba for the first time, especially out of spirits, often find it pleasant to the taste. The first eructation, however, destroys the illusion, and gives an entire disgust to what they had found so pleasant.

Copaiba has been known as a remedy for gonorrhœa since the year 1702, and that it will cure many patients must be admitted. Still it often fails: sometimes makes everything worse, and no one can tell the cases in which it will or will not succeed. Mr. Hunter thought so little of this remedy, that he affirms "there is no specific antidote for gonorrhœa;" "that treatment is seldom of any kind of use, perhaps not once in ten cases;" and, upon the conviction that every gonorrhœa cures itself, he adds, "I gave certain patients pills of bread, and the patients always got well, but some of them, I believe, not so soon as they would have done had the artificial methods of cure been employed." Ricord says that it seldom stops the discharge on the instant "*d'emblée;*" or, should the discharge rapidly cease under its use, it often re-appears on discontinuing the medicine, and again disappears on resuming it,—so that to obtain a durable effect, the patient must continue its use for eight or ten days after the cessation of all discharge. Ricord conceives the best chances of success are, to exhibit it during the first four days from the first appearance of the disease, or else after the acute stage is passed. This eminent surgeon, however, is so little satisfied of its specific properties, that he recommends our applying twenty, thirty, or forty leeches to the perinæum in every case where pain is present, before we exhibit the copaiba. Another of his methods also is to introduce an armed bougee to superficially cauterize the urethra, or else a graduated injection, beginning with a quarter of a grain of nitrate of silver to an ounce of water, and gradually increasing it till some effect is produced.

Another substance has been for some years used for the specific or abortive treatment of gonorrhœa, or cubebs. This medicine is admitted to offer much fewer chances of success than copaiba; indeed it seldom stops the discharge at once. It is singular that a substance so powerfully pungent should be taken in many cases throughout the whole disease without apparently influencing its course. These are the means we possess for attempting the cure of gonorrhœa by a specific or abortive treatment.

Daily experience, however, shows that gonorrhœa often terminates spontaneously, and without the aid of medicine; and its usual course, when the patient is continent and abstains in a great measure from animal food, from wine, and from strong exercise, is to attain its height in about a week; to continue in this state about a fortnight, and then gradually to decline, so that at the end of five or six weeks the disease terminates. In ordinary cases, therefore, it will be plain that, although much prudence is necessary, still that much medicine is not essential. A general treatment is consequently often substituted for the specific, and the usual method is some gentle purgative to slightly act on the bowels, as the sulphate of magnesia or the iodide of potassium. Mr. Carmichael recommends an addition of the solution of tartarized antimony to the former salt; that medicine, preventing "the patient from indulging a good appetite, lessens inflammation, and is the best preservative against painful erections or chordee." In the second stage. if it should be thought necessary, he directs, and it is the practice of the profession generally, the use of copaiba in as large doses as the stomach will bear, or else of cubebs; but the latter medicine, he states, has in the majority of cases disappointed his expectations.

There are many persons, however, who prefer an entirely local treatment, or are induced to conjoin some local measures with the general treatment. The simplest practice is, as soon as the discharge appears to direct the patient to steep the penis in moderately hot water for a few minutes, or till a degree of faintness is produced, and to repeat this fomentation two or three times in the twenty-four hours. This mode of applying heat is exceedingly exhausting, and if the disease be indolent often removes it in a few hours.

A treatment by injections, however, is more practised; and the forms of injection are without number, every practitioner thinking, or wishing to make the world think, his own the best. Some venture to throw up one so powerful as to be composed of ten grains of nitrate of silver to an ounce of distilled water. Ricord recommends a graduated injection, beginning with a quarter of a grain of nitrate of silver, and gradually increasing the quantity till some decided effect is produced. He also recommends the acetate of lead, or the tinct. opii. Mr. Carmichael recommends half a grain to a grain of the oxymuriate of mercury in six or eight ounces of lime-water, or from two to four grains of the sulphate of zinc or of the sulphate of copper in the same quantity of rose or other distilled water. But formulæ for injections are without number.

Mr. Hunter's direction for using injections ought never to be forgotten. "I think," he says, "irritating injections should never be used when there is much inflammation, especially in constitutions that will not bear a great deal of irritation. Nor should they be used when the specific irritation has spread beyond the specific distance; nor when the testicles are tender, nor when the discharge ceasing quickly they have become sore; nor when the perinæum is very susceptible of inflammation, especially if it has formerly suppurated; nor when there is a tendency in the bladder to irritation, which is known by the patient having had for some time a frequency in making water. In such cases I have not succeeded with them; they not only do no good, but frequently do harm, for I have seen them make the inflammation spread further in the urethra, and I think I have had reason to suspect that they have been the cause of abscess in perinæo. But in cases that are mild, and in constitutions that are not irritable, injections often succeed, and remove the disease almost immediately. The practice, however, ought to be attempted with caution, and not perhaps till milder methods have failed. Emollient injections are the most proper applications; and where the inflammation is very great indeed, we often find that a solution of gum-arabic, milk and water, or sweet oil will lessen the pain and other symptoms when the more active injections have done nothing, or seemed to do harm."

When injections are had recourse to they should be used cold, and thrown up three or four times a-day with a moderate force. The patient should seat himself on a chair, introduce the pipe, and then pressing the lips of the urethra gently, allow the injection to run down the canal. As soon as the discharge is stopped the injection should be left off.

In spite of the above local and general treatment the discharge may continue, and the disease, after a few weeks' duration, is now termed a gleet. The cause of the continuance of the discharge is supposed to depend on some irritation of a limited portion of the urethra. This point is sometimes situated towards the meatus urinarius; at others towards the bulb; and, according to Beaumés, in eight out of ten cases towards the prostatic portions of the canal. In this state of parts this gentleman recommends a catheter to be passed, in order to determine the exact distance of the prostatic portion by ascertaining the point at which the urine does not flow. He then withdraws it, and, introducing an armed catheter, cauterizes the affected part. Ricord carries this practice still further, and cauterizes the whole urethra. When the diseased portion is in perinæo, much advantage has been derived from a few leeches, or from a blister.

When the *testicle* becomes inflamed and enlarged in this disease, quiet and a horizontal position are essentially necessary. The patient should also be placed on a low or milk diet. The medical treatment consists of the application of fifteen, twenty, or more leeches, according to the severity of the attack, to the scrotum, and, on their falling off, fomentations or a linseed poultice should be applied, to encourage the bleeding and to assuage the pain, and when the pain is excessive forty to sixty drops of tinct. opii may be sprinkled over the surface of the cataplasm. This treatment often gives relief in a few hours; but should the pain recur the leeches should be repeated, and in all cases the patient should either foment night and morning, or repeatedly change the poultice. Besides the local treatment, internal medicines are of essential benefit, and of these the iodide of potassium is perhaps the best, and eight or ten grains given three times a day often greatly accelerates the cure. When mercury is given it should be in alterative doses, and with or without the sulphate of magnesia, according to the state of the patient's bowels. Under this treatment the disease is speedily mitigated, and generally subsides in ten days or a fortnight. In some cases, however, from improper treatment, or from other cause, the testicle remains much enlarged and greatly indurated. In this state an ointment, composed of a drachm of the iodide of potassium to an ounce, should be gently rubbed over the affected testicle night and morning. The iodide of potassium also taken internally, in the usual dose, still continues

Elementary Principles of Medicine.

to be the most valuable remedy under these circumstances.

Should *chordee* exist in any severe degree, it is important to assuage the sufferings produced by this state of parts, and, besides cold to the part, the most powerful remedy is ten grains of camphor combined with one grain of opium, in pills or as an enema. Ricord states that this treatment is asked for every day in the wards of the hospital by those patients who have already made trial of it.

In the treatment of gonorrhœa in the *female* it is generally admitted that the specific treatment by copaiba or by cubebs is entirely inert, or only useful when perhaps the urethra is affected. In general, then, the treatment of gonorrhœa in females is extremely simple, or by rest, low diet, and diluents, and especially by a weak solution of the nitrate of potash and frequent warm ablutions, or emollient injections, or, should the bladder be affected, a large cataplasm may be applied over the abdomen. In addition to these means, the bowels should be kept freely open, and, if the symptoms be extremely severe, some blood may be taken from the arm, or locally by leeches, as may be thought best.

When the acute stage is passed, astringent injections may be had recourse to, and Ricord recommends the acetate of lead or alum, in the proportions of an ounce to an ounce of distilled water, and, by the aid of injections and of pledgets steeped in these solutions, he estimates that sixty women out of a hundred are cured in the space of twenty days to two months. In still more chronic cases the injection often requires to be varied, and those of the sulphate of zinc, of oak-bark, or of hydrargyri oxymuriatis are among those most commonly substituted. In cases where granulations have formed, or a slight ulceration exists at the orifice of the urethra, the diseased portion should be cauterized with the nitrate of silver or other escharotic.

Emollient fomentations and injections should be used warm, but astringent injections should be used cold. They should be thrown up by means of a syringe with a bent pipe, terminated by a bulb pierced with holes, and the pipe should be of that length that it may be introduced into the vagina without hurting the neck of the uterus. The position of the patient is not indifferent, and she should be recommended to inject in bed with the pelvis raised.

In the treatment of *gonorrhœal ophthalmia* in either sex the means must be active, and any hesitation in their employment, says Ricord, "frequently occasions loss of sight." If the patient be strong, blood should be taken from the arm, and twenty, thirty, or forty leeches should be applied on a level with the alæ of the nose and in the course of the jugular vein, but carefully avoiding the eyelids. Many practitioners now content themselves with applying emollient poultices, but Ricord recommends that the eyelids be inverted and the palpebral, as well as ocular, conjunctiva be cauterized with argentum nitratum until the surface is whitened; and this being done, cold water should be injected, so as to wash the nitrate of silver off the conjunctiva and cornea. As soon as this slight operation is finished, the eye is to be covered with compresses steeped in a cold decoction of poppy-heads, and this cauterization may be repeated every day or every second day. Should ecchymosis exist, he recommends the affected part to be removed by means of hooked tenacula and the curved scissors.

The treatment of stricture, and of diseases of the prostate resulting from gonorrhœa, is so completely within the province of surgery that the reader is referred to the popular works on that branch of medical science for the methods usually employed in these cases.

Of the Poison of Hydrophobia.

Hydrophobia is a simply contagious disease, originating in certain animals, and propagated by their bite. The action of this poison is principally on the brain and eighth pair, causing a peculiar dread of swallowing fluids, which is the characteristic symptom of the disease. Fifteen deaths from this cause are reported to have occurred in England and Wales in the year 1830.

Much speculation has been entertained, whether hydrophobia is of such antiquity as to be mentioned in the writings of Homer; but all authors are agreed that it was known as a disease affecting both the human subject, and also animals, to Aristotle, and subsequently to Celsus, to Pliny, and to Galen.

Remote Cause.—Hydrophobia originates in animals of the canine and feline races, as the dog, the fox, the wolf, the jackall, and the cat, probably from atmospheric causes, but from what peculiar source is altogether undetermined. It is, probably, at all times to a certain extent endemic, and occasionally epidemic among these animals. It has been supposed that it is excited in them by the great heat of the dog-days, or by the æstus veneris; but Troillet has shown that canine madness occurs with nearly equal frequency in winter, spring, summer, and autumn. The poison is not peculiar to any country, for hydrophobia is found equally in Europe, Asia, and America; neither is it limited to climate, since it prevails in the frozen regions of Canada, as well as in the East and West Indies. The difficulties attending the origin of this poison are at present not to be surmounted; but hydrophobia once originated in the animals that have been mentioned, they have the power of producing it by their bite, not only in each other, but probably in all warm-blooded animals, certainly in all domesticated animals, as the horse, the elephant, the sheep, the ox, even in the common fowl, and also in man. Happily, neither man nor any of those animals who are only liable to it in consequence of inoculation by the poisoned bite, are capable of further propagating the disease. It will be necessary, to the proper understanding of hydrophobia, to give a short outline of it as it occurs in the dog, so constantly associated with us in domestic life, and the principal source of the disease in the human subject.

The symptoms of this formidable affection, as witnessed in the dog, are some singular departure from his ordinary habits, such as picking straws or small bits of paper off the floor, and swallowing them, also licking the noses of other dogs, or other cold surfaces, as stones or iron. Besides this, he is observed to be more lonely, shy, and irritable; is less eager for his food, or refuses it altogether. His ears also, and his tail, drop; his look is suspicious and haggard; and sometimes, from the very commencement, there is a redness and watering of the eyes. In a short time saliva begins to flow from his mouth, he "slavers," and his fauces are said to be inflamed, and he is feverish. The animal, though highly irritable, and easily provoked, still obeys the voice of his master, and it is remarkable, says Mr.

Youatt, "that the dread of fluids, and even the sight of them, so striking a feature in man, is often wanting in dogs and other animals, for many dogs lap water during the disease." In many dogs the symptoms never rise higher than these, but in others there is a repugnance to control, and a readiness to be aroused to extreme rage on the appearance of a stick, whip, or other instrument of punishment, or on any attempt at intimidation, which strikingly characterizes the disease. Even in this state, however, he seldom fights a determined battle, but bites and runs away; still even this mitigated irascibility usually ends in indiscriminate aggression, till at length he dies, and apparently of convulsions.

Examination of the dead body has often shown that the animal has died from mere nervous excitement and functional derangement; for Majendie has inspected the hydrophobic dog, and found nothing. In all cases, however, in which the poison has had time to set up its specific actions, the principal lesions of structure are found to be in those parts supplied partially or entirely by the eighth pair; for the tongue is swollen, the fauces, the salivary glands, and the angle at the back of the larynx behind the epiglottis, is also occasionally inflamed. The bronchial membrane is also occasionally inflamed, and so is also the mucous membrane of the stomach, which generally contains a strange mixture of straw, hair, hay, horse-dung, and earth, showing the peculiar morbid propensity of the animal; or being void of those substances, contains a fluid resembling the deepest coloured chocolate. Such are the symptoms and phenomena of hydrophobia in the dog, the chief source, perhaps, of this fatal malady to the human race.

Predisposing Causes.—The susceptibility of the human subject to this poison is by no means universal, for only ninety-four persons died of one hundred and fifty-three bitten, making the chances of escape as three to two nearly. It has been thought this occasional immunity does not arise out of any want of susceptibility to the action of the poison, but from the party having been bitten through his clothes, and the dog's tooth, consequently, having been wiped clean from all venom. Menières, however, says he met with seven cases in which the dog must have bitten through several folds, and yet they all proved fatal; showing, as he imagines, the little importance of dress as a protection from this malady.

Neither age nor sex are exempted from hydrophobia, for the infant at the breast, as well as a man aged seventy-three, have equally died of this disease.

Contagious.—The proof of this law is, that no instance is known of man being affected with hydrophobia, unless antecedently bitten by a rabid animal, capable of communicating the disease.

It is a question of much moment, whether the saliva of a patient labouring under hydrophobia will or will not communicate the disease. It may be stated as an undeniable fact, that during the many hundred years hydrophobia has been studied, that no instance is known of this disease having been communicated from one human being to another, although many instances have occurred of the attendants having been bitten, or otherwise accidentally inoculated with the saliva of the hydrophobic patient. The only instance which makes this law at all questionable is a case given by Majendie, in which he inoculated a dog with saliva taken from a diseased patient, and the dog shortly afterwards died of hydrophobia. But the previous state of the health of the animal had not been ascertained, and as all similar experiments made to prove this fact had failed, it may be presumed that had greater precaution been used, no such sinister accident would have resulted.

Fomites.—The dog's tooth is distinctly a fomes.

Co-exists.—No instance illustrative of this law at present exists.

Modes of Absorption.—This poison is probably absorbed equally by the cutaneous and mucous tissues, but probably an abrasion is necessary. The ancients were aware of this, for Celsus observes that the integrity of the lining membrane of the mouth is necessary to the operation of the psylli, whose office it was to suck out the poison after the bite of a rabid dog; and Dioscorides expressly orders them first to wash their mouths with astringent wine, and afterwards to lubricate the cavity with oil. With regard to dogs, Mr. Meynill observes that "such of them as have been thought to become affected merely by the contagion of the same kennel, will generally be found upon minute examination to exhibit the marks of bites, though concealed by the hair." When a scratch or other abrasion exists, a rabid dog merely licking the part is sufficient to infect the patient.

Period of Latency.—In the human subject, after the poison has been absorbed, it lies in latent combination with the blood from a few days to twelve or more months, the average period being about six weeks. At the Veterinary School at Alfort, it is the practice, when a dog has been bitten, to chain him up for fifty days, and at the end of that period, if he continues in health, he is restored to his master, not that he is now considered as absolutely exempt from danger, but that his chances of escape are greatly increased.

Pathology.—The theory of this disease is, that the poison is absorbed and infects the blood, and that after a period more or less long, produces functional derangement of the brain and nervous system, and subsequently organic alteration of the structures principally supplied by the branches of the eighth pair.

The action of the poison in the first instance is on the œsophageal branch of the eighth pair, producing that derangement of function which gives rise to the characteristic symptom of the disease, or to the extreme difficulty of swallowing, especially of fluids; while the spasmodic catching of the breath, consequent even on touching the lips with any liquid, proves that the recurrent nerve is equally affected. Subsequently, the eye and ear become distressed by every ray of light or impulse of sound, and likewise the sense of touch is most painfully excited, on the slightest breath of air passing over the surface of the body, all of which distinctly show that the central and spinal nerves must be functionally affected. In a still more advanced stage, the suspicion, the irritability, the violence, and generally the outrageous and uncontrollable derangement of mind which often seizes the patient, bringing on epilepsy and convulsions, show that the brain itself is likewise a principal seat of the action of this terrible poison. These symptoms are often so violent as to cause the death of the patient; and the bodies of many persons have been examined, in whom not a trace of inflammation or other morbid phenomena have been discovered; and, consequently, hydrophobia is essentially a disease of function. More commonly, however, some structural alterations have been found limited to slight inflamma-

tion of the brain, the chord, or of their membranes, and also of the lungs or stomach, structures supplied by the eighth pair. Still the law of election prevails in this disease, and the brain, the lungs, or the stomach, may be either separately or conjointly affected—facts in no degree dissimilar to what have been observed in hooping-cough, fever, and in many other diseases caused by morbid poisons.

It is doubtful, however, whether the actions of the poison end here, for in a case treated by Majendie, and prolonged beyond the usual period, suppuration of the synovial membranes of the joints took place, and produced a state of suffering remarkable even in this frightful disease, and far more terrible than death itself. Such organic lesions as have been found are as follows:—

When the membranes of the brain have been found diseased, the appearances have been great congestion, especially of the plexus choroides, also effusion of serum into the arachnoid cavity, and also into the ventricles. The brain has also in some very few cases been supposed to be harder or softer than usual, and also to have more bloody points than in health. The mucous membrane of the pharynx and œsophagus have also been met with, either greatly congested, or diffusely inflamed, as also that of the stomach, and of the trachea and bronchi. The latter also have been found covered with a considerable quantity of frothy mucus, while the pulmonary tissue has shown marks of inflammation, though more commonly only of great congestion. The salivary glands have likewise occasionally been observed increased in size and vascular. The chord has been supposed by some pathologists to be the great and specific seat of the hydrophobic poison, and its substance as well as its membranes has been found congested; but still few cases are on record in which any traces of inflammation were discoverable. This state of parts, therefore, is merely owing perhaps to the incessant violence and struggles of the patient, and might have been predicated *a priori*.

Symptoms.—The wound inflicted by the bite, whether neglected or dressed, generally heals up kindly, leaving a cicatrix, and for a time the patient usually suffers no other derangement of health than the depression of spirits which his apprehensions are calculated to excite. A few weeks or a few months having elapsed, the latency of the poison terminates, and the disease is formed. The course of this affection is usually divided into three stages; the first stage comprising the symptoms which precede the difficulty of swallowing; the second commences with the difficulty of swallowing, and terminates with the overthrow of the mind: the last stage embraces all the concluding phenomena.

The first stage commences in a few instances by the patient's attention being aroused by a pain felt in the cicatrix, sometimes severe and sometimes trifling, and which shoots up the bitten limb, following in general the course of the nerve towards the heart. Pain, however, is by no means constant, and is for the most part absent. In the latter case, the first symptom is chilliness, with headache, or a slight attack of fever, and the patient is more excited or depressed than usual. These premonitory warnings last but a few hours, or at most a few days; when the fatal but characteristic symptom, "the difficulty and dread of swallowing," a symptom which distinguishes this malady from all others, appears, and the hydrophobic stage commences.

The second or hydrophobic stage is ushered in with a great difficulty, if not an utter impossibility, of swallowing any liquid, a symptom which generally comes on suddenly; and such horrible sensations accompany that effort, that whatever afterwards even recalls the idea of a fluid excites violent agitation and aversion. Some patients who have been able to give some account of themselves, describe the hydrophobic sensation as a rising of the stomach, which obstructs the passage, others as a feeling of suffocation, or a sense of choking, which renders every attempt to pass liquids over the root of the tongue not only impossible, but also excites convulsive action in the muscles of the larynx, pharynx, and abdomen. In this state, says Dr. John Hunter, "the patient finds some relief from running or walking, which shows that the lungs are not yet the seat of any great oppression."

The hydrophobia, or inability to swallow fluids, is shortly accompanied by an increased flow of saliva, termed the "hydrophobic slaver." This secretion, as the disease advances, is not only copious but viscid, so that it adheres to the throat, and causes incessant spitting, and the quantity expectorated may be taken as the measure of the violence of the disease.

The aversion to fluids is no sooner established than another series of symptoms of dreadful severity, or a highly exalted state of every corporal sense, is added. Indeed it is hardly possible to depict the sufferings of the patient from this cause, for not only does he shrink at the slightest breath that blows over him, but the passage of a fly, the motion of the bed-curtain, or any attempt to touch him, produces indescribable agony, almost amounting to convulsions. The sense of sight is no less a source of terror than that of touch, for the approach of a candle, the reflection from a mirror or other polished surface, occasions the same distressing effect. The hearing is also as strongly affected as the other senses, so that the least noise, and especially that of pouring out fluids, throws him into a fearful paroxysm. One of the dressers who sat up with a hydrophobic boy, making water within his hearing, threw him into a most violent agitation. The degree to which this painful state of the senses exists may be understood when it is stated Majendie gives the case of a deaf and dumb child, who heard distinctly in this stage. The patient, thus incessantly harassed and pained by every circumstance around him, becomes peevish and irritable, and at length sees his family, relations, and strangers, with feelings of dislike and aversion, and sometimes apparently with horror.

The third stage commences by the cerebral functions becoming disturbed, the mind being either filled with dreadful apprehensions, or else being so completely overthrown, that paroxysms of furious insanity, or fits of epilepsy, follow. In this stage horror is strongly depicted on the countenance, every symptom is aggravated, the saliva grows thick and ropy, while the poor sufferer, not daring to make the slightest attempt to swallow, spits it out incessantly, oftentimes with frequent retching and vomiting. In this state he sometimes turns black in the face, and calling out he is suffocated, falls into convulsions in which he expires, or else, exhausted by his great efforts, a sudden calm ensues, and as if nature gave up the struggle, dies without a groan.

Diagnosis.—When hydrophobia is fully formed, there is no disease with which it can be confounded; but

there are many reported cases in which the imagination of a patient bitten by a dog has been so powerful as to similate the disease. In hysteria the difficulty of swallowing exists, but no other symptom.

Prognosis.—There is no instance of any patient or animal suffering from this disease having recovered.

Treatment.—As there is no well authenticated case of recovery from hydrophobia, neither is there any instance, or but rarely so, of any mitigation of the symptoms by the use of medicine. All that remains then is to mention the most leading experiments that have been made, with the hope that, as they have not been successful, they may not be repeated.

Dr. Hamilton gives twenty-one cases, and adds, many hundreds more are on record, in which venesection has been unsuccessful, though copious and often repeated. Opium has been given by Dr. Babington to the enormous amount of 180 grains of solid opium in eleven hours, without the slightest narcotic effect, or the slightest mitigation of the symptoms. Nord has given a drachm of belladonna in twelve hours, without any benefit. Dr. Atterly gave to a child eight years old two drachms of calomel by the mouth, and also had rubbed in two ounces and a half of strong mercurial ointment in a few hours, and with an equal want of success. Iron, arsenic, nitrate of silver, camphor, musk, cantharides, turpentine, tobacco, acetate of lead, cuprum ammoniatum, hydrocyanic acid, galvanism, strychnine, nitrous oxyde, chlorine, and guaco, have been also given in equally large doses, but have signally failed. These include some of the most powerful medicines in the Pharmacopœia; and, in addition to these, Plouquet, in his *Literatura Medica Digesta*, has enumerated nearly 150 others.

The failure of every remedy by the mouth, and the powerlessness even of opium, of morphine, and of laurel water, even when injected into the veins, so convinced Majendie that, in hydrophobia, the constitution was armed against the action of any medicinal substance, that on a patient labouring under this disease being brought to the Hôtel Dieu, he determined to rely for all treatment on an injection of warm water into the veins. The patient at the time of the operation is represented as being absolutesly insane, so as to require to be confined in the strait waistcoat. In this state, and with a pulse of 150, Majendie injected into his veins, in the course of two hours and a quarter, two pints of water at the temperature of 100°. At the conclusion of this operation, the pulse had fallen to 80, and the patient recovered his senses, so that the strait waistcoat was no longer necessary. The sequel, however, renders it doubtful whether this mitigation was desirable at the price of the intense suffering which followed. The poor man lived eight days afterwards, but the despondency and mental agitation quickly returned, and at the end of three days the poison appeared to set up a new series of specific actions on the synovial membranes of the wrists, elbows, and knees, attended with excessive pain, so that he was unable to bear the weight of the bed-clothes, and he died in great torture. The articulations thus affected were found on posthumous examination to be greatly inflamed, and their cavities filled with pus. This case is remarkable, as being the one in which life was prolonged for the greatest period of time recorded of this disease. The experiment has since been repeated by Gaspard and others, but the mitigation, if any, has been so slight and transient as to give no encouragement for repeating it; and tried on the rabid dog by Mr. Youatt and Mr. Mayo, it proved eminently unsuccessful.

The property which some animal poisons have of controlling and of interrupting the actions of other morbid poisons on the constitution, has caused this class of agents to be tried in the cure of this disease. The rapid and powerfully acting poison of the viper led to the hope that the bite of that reptile might prove an antidote to the hydrophobic virus, but the experiment, tried in France, Germany, and Italy, has been entirely unsuccessful. M. Grindard conceived that the vaccine virus might influence hydrophobia, and he vaccinated a hydrophobic child in three places, and afterwards injected five charges of vaccine lymph into the veins, but the child died without any marked remission, and in the usual time.

Preventative Treatment.—In the East Indies, after the bites of the venomous serpents of that country, the patient usually lies speechless and insensible in less than an hour. The probabilities therefore are, that unless the operation of excision, of cauterization, or of applying the cupping-glass be performed within a few minutes after the bite of the rabid animal, it is impossible to save the patient from the fatal disease, which, according to the susceptibility of his constitution, now threatens him. In all probability no prophylactic medicine exists in nature, and the exhibition of any potent substance by way of prevention is worse than useless, for without protecting the patient it injures his constitution. Mild remedies, if they tend to tranquillize his mind and to appease his apprehensions, may be innocently employed.

Of the Poison of the Plague.

The plague is a simply contagious disease, generally marked by fever. The more specific actions of the poison are, inflammation of the lymphatic glands, and the formation of carbuncle.

Every epidemic disease of great severity, or of unusual character, was formerly termed "the plague," and considered as belonging to an order of supernatural events; as the infliction of an offended deity to punish the sins of a disobedient people. The long catalogue of calamities which history records under this name consequently embraces every epidemic disease that has fallen on man. Modern medicine, however, restricts the term "plague" to a disease of dreadful severity, and of a peculiar character, which appears to have its origin in Egypt, and in the neighbouring countries, and is unquestionably the result of physical causes.

It is impossible to determine the time when the plague first appeared in Egypt. Some writers consider it to have been coeval with Moses; while others contend that it was unknown as late as the Augustan age, and consequently is of "secondary formation." The remotest period to which we can distinctly trace it is when we find it spreading into other countries; and the plague of Constantinople, which broke out in 544, when Justinian was emperor, is the first which, from its course and symptoms, we can with certainty determine to be the plague of modern times. It was so severe that at one period ten thousand persons are said to have died daily in that city. Procopius has distinctly traced it to Egypt, and states that it spread successively over the whole empire, making its first attacks on the coast, and then spreading into the interior. The symptoms were shivering

and fever, at first so slight as to alarm neither the physician nor the patient, but the same day, the next day, or the day after, there appeared swellings of the parotid, axillary, or inguinal glands, with carbuncles, and sometimes gangrene, and from the more usually diseased state of the glands, it was called "pestis inguinaria." These symptoms are those of the Egyptian plague, and nobody can doubt the identity of the two diseases.

The plague, from that period, has raged at short intervals in various parts of Europe, as late as the seventeenth century, so that Sir Gilbert Blane has calculated there were no less than forty-five plagues in the seventeenth century. Fourteen of them occurred in Holland, in consequence, it is supposed, of the Dutch having engaged in the Levant trade, about the year 1612; and twelve in England, imported, as has been supposed, from Holland. The last plague which raged in either of these two countries was in 1665, or the year before the memorable fire of London. This plague was termed the "Great Plague," and spread "with such intolerable infection," that 7165 persons are said to have died in one week, while in one year no less than 68,526 died in the city of London and its suburbs alone; an immense mortality, considering the then comparatively small amount of population.

The plague is still annually epidemic in Egypt, and very constantly rages on the Barbary, Arabian, and Syrian coasts, and also at Constantinople; but has been rarely seen out of the Turkish dominions since the seventeenth century. Nevertheless it broke out at Copenhagen in 1712, at Marseilles in 1720, and at Moscow in 1771. In the present century it has appeared at some of the Russian ports in the Black Sea. In 1813 it broke out at Malta and at Gozo, when the losses it occasioned were estimated at a million sterling, and the number of victims at between 4000 and 5000. It subsequently broke out at Noja in Calabria, in 1816, at Corfu, in 1818, and lastly it appeared at Gussemberg in Silesia, in 1819.

Remote Cause.—The plague, and consequently the poison which it generates, has undoubtedly a very limited origin. Clot Bey indeed considers it to originate, and to be endemic, along the whole of the eastern and southern coasts of the Mediterranean; the principal centres being Egypt, Syria, and Constantinople. But most authors are agreed that Egypt alone originates the plague, whence it is imported into other countries. It seems determined also that the poison is not only generated in Egypt, but also within a very circumscribed space of that country; for Volney states that the plague in Egypt never commences in the interior, but always appears first on the coast at Alexandria, passes from Alexandria to Rosetta, and from Rosetta to Cairo; and consequently he considers that the poison must be generated in the Delta of the Nile, and this fact is confirmed by all subsequent writers.

Of all the causes mentioned by authors as originating the poison of the plague, the crowded state of the population in Egypt, their misery and insufficient nourishment, are the most prominent. Every writer speaks of their mud-built huts, of their narrow and tortuous streets, and of their habitations, whether isolated, in villages, or in towns, being surrounded in every direction with heaps of dung and other immundities. In these the Arab lives with his wives, his children, and his servants, and his domestic animals, all huddled together. "Unheard-of filth," says Clot Bey, "reigns in their infected taudis." Again, some authors have considered the pestilential miasma as a product of vegetable decomposition, favoured by the inundation of the Nile, and the heated blast of the hot Khamsin; others, that it is owing to the mud deposited by the Nile; and lastly, that it is owing to the practice of making mummies of the dead, or of imperfectly and superficially burying them. Clot Bey has examined all these causes, and comes to the conclusion that, taking them conjointly or separately, they are inadequate to account for the origin of the plague. Of the many other hypotheses imagined, the generation of a peculiar animalculæ, flying from place to place, is the most ingenious, and perhaps the most unfounded theory. All, therefore, that we can safely affirm of this poison is, that it is probably of secondary formation, has a local origin, is at all times endemic in Egypt, and every five or six years epidemic. It also appears to be to a certain extent influenced by season, the plague not spreading in any very sensible degree till December, and attaining its greatest height in June, when it rapidly declines, and is popularly supposed to cease on St. John's day.

The period of the year, however, at which the plague prevails differs in some degree in different countries; but the total duration of the disease in any country to which it is not native appears to be inconsiderable, unless kept up by a fresh importation. At Aleppo it lasted from 1760 to 1762, a period of three years. But in Malta, Marseilles, and in the western parts of Europe, it has generally subsided in about a twelvemonth.

We are little acquainted with the habits of this poison as it affects animals. Dogs are said to have died of buboes, either during or just preceding the plague season; and bile taken from a deceased plague-patient, and injected into the veins of a dog, was followed by the death of the animal. Boccaccio says he saw two pigs die of the plague in 1348; and Aubert states he was credibly informed that many oxen had died with buboes during the late plague of Alexandria. Clot Bey, however, is sceptical about all these facts.

Predisposing Causes.—In every epidemy there is only a certain number of persons greatly susceptible of the action of the poison, else every town or city attacked must be depopulated. The proportion of persons, however, liable to be attacked by the plague is very great, for in that of Alexandria, in 1834, it is calculated, out of 42,000 souls, 14,888 perished. In selecting, however, its victims, this poison follows the law of most other morbid poisons, attacking the poor rather than the rich,—women rather than men,—patients labouring under disease rather than healthy individuals,—persons constitutionally feeble rather than the robust, and those addicted to intemperance or other excess than those who more strictly observe the precepts of Mohammed. As to races—the Arab suffers more than the Negro, the Negro than the Turk, and, in Egypt, the Turk than the European.

Contagious.—The belief in the contagious nature of the plague is so general that it still continues to be the terror of Europe, and the ports of every nation are closed against a vessel supposed to have the plague on board. The facts by which this precaution is warranted are extremely striking, for every time the plague has appeared in Christian Europe the arrival of a ship on board of which one or more persons have died of the plague has been an invariable antecedent. The disease also has invariably first broken out at the port or town

at which such vessel has arrived, and if the proper precautions have been taken, has not spread, or only in a trifling degree, into the interior of the country. The following modern examples of the plague appearing in the West of Europe will exemplify this statement.

On the 25th of May, 1720, Marseilles being healthy, a vessel arrived in that port from Seyda, in Syria, having lost seven men, during the voyage, of the plague. It was usual to send vessels and their crews arriving under these circumstances, or having foul bills of health, to perform quarantine at Jaru, an uninhabited island near Marseilles; but this precaution was omitted in the present case, and so negligent were the officers on duty, that the captain and passengers were permitted to land, and even to lodge in the city, while the crew were sent to the infirmary and allowed to associate with the persons attached to that establishment. It appears also that many contraband articles were thrown over the walls. In the midst of this free communication one of the seamen died of the plague, then the *garde de vaisseau*, then the cabin-boy and two porters, and lastly, on the 20th of June, the plague broke out in the city itself, and raged with such fury that out of a population of 90,000 souls, it was estimated 39,134 died. It spread in Provence, and caused considerable mortality in that department; but, nevertheless, it was limited to a comparatively small district of country immediately around the original focus of infection.

In the year 1743, Messina being healthy, a ship arrived on the 20th of March from the Levant, and three men having died during the voyage, the ship was put under quarantine in the harbour. Two days after the captain died of the plague, and shortly after another of the crew; when, in consequence of this, the ship, ten days after her coming to anchor, was taken to a distance and burnt, with all her cargo. Forty days after the plague broke out at Messina, when 38,000 persons are said to have died of the disorder.

In the year 1813, Malta being healthy, a vessel called the 'San Nicolo' arrived on the 29th of March from Alexandria. On entering the port she hoisted the yellow flag with a black spot in the centre, the signal of the plague on board; and the master reported two men had died on the voyage, and as he believed of the plague. The same day also there arrived two other vessels, likewise from Alexandria—the brig 'Nelly,' and the Spanish polacca 'El Dolce,' which had likewise lost some men on the voyage.

The arrival of three vessels on the same day suspected of having the plague on board alarmed the city, and the 'Nelly' and the 'El Dolce' were sent away the next day, while the 'San Nicolo,' belonging to a merchant resident in the island, was put under quarantine; and on the third day the captain was seized with symptoms of the plague, and died in thirty-six hours; and his servant was seized about the same time, and he also died. On the 16th of April following, the first death from plague occurred in the city of Valetta; and on the 3rd of July, the disease had spread so extensively that the organization of a police was begun for the purpose of isolating the city and "shutting up" its inhabitants. It is remarkable that although the plague spread to many towns or villages in the island, that no sooner was that town or village surrounded by a cordon of troops, and thus isolated, than the disease was limited to that spot, and never spread in any instance to the troops immediately without it.

It is manifest that the antecedent arrival of a vessel having the plague on board at each of the three ports of Marseilles, Messina, and Malta, and the breaking out of the disease in all those places shortly afterwards, is so remarkable that it can be only explained by admitting the connexion of cause and effect. Moreover, the fact of the plague having originated in the preceding instances from imported contagion, and not from any local influence, is demonstrated by the exemption of large bodies of persons "shut up" in the very heart of the pestilence. Thus, in the plague at Marseilles, the large nunnery of des Dames de la Visitation Sainte Marie "shut up," and, although there was an infirmary on one side, for those ill of the plague, and a burying-ground on the other, for those who died of the plague, yet all the inmates of the nunnery escaped. The Hôpital de la Charité of the same city, a sort of poor-house, making up about 300 beds, "shut up," and escaped with complete impunity; but being converted into an infirmary for the plague patients, 200 of the poor left in attendance all died of the plague. In the plague of Moscow, 1770–1771, the Imperial Foundling Hospital, containing 1400 souls, "shut up," and although more than 100,000 persons are supposed to have fallen victims to this pestilence in that city, yet, except some eight persons who surreptitiously went into the city, and were instantly separated, none caught the disease. The exemption also of the Convent St. Augustin, which "shut up;" of the town of Isola, which "shut up;" and the singular exemption of all the military, "though they surrounded within a yard or two camps and hospitals in which the plague was raging, and, lastly, were subjected to those hard duties which are known to give a predisposition to inflict on soldiers the most violent type of the prevailing disease,—but they never caught the plague at all," are further proofs that the plague was not communicated through the medium of the atmosphere.

Another class of facts demonstrative of the contagious nature of the plague is the greater number of persons attending on or in communication with the sick who fall from the plague. The French army, on first taking possession of Egypt, lost no less than eighty medical officers by the plague, an immense proportion compared with the loss of the army generally. In the English army only one in forty-eight of the army generally died of the plague, while one-half of the medical officers died. On the contrary, in Malta and in Corfu, the medical officers dressed themselves in oil-skin dresses, and, thus protected, often slept in the wards, yet not one of them was attacked by the plague. Some few persons also have ventured voluntarily to inoculate themselves with plague-matter, and these have, with hardly an exception, fallen victims to their rash experiments.

Such is a general view of the facts proving the contagious nature of the plague. It must be admitted this law is doubted by Aubert and Clot Bey; but when we find the Pacha of Egypt and his court carefully "shutting up," and that quarantine establishments are formed at Alexandria and Constantinople, it is impossible not to see that these doubts are not entertained by the higher ranks of the Mohammedans, while it is well known that all the Christians of any fortune in the Levant are such contagionists as constantly to "shut up" on all similar occasions.

Fomites.—By the contagion *per fomitem*, as it is termed, the plague has been supposed to spread, not

only from person to person, but from one quarter of a town to another, and also to remote and distant countries. The following are instances of this law.

"In the plague of Moscow," says De Mertens, "the principal victims consisted of the lower order of the Russians, and these bought up everything that was rescued from the flames." When the French army was in the occupation of Egypt there were so many instances of a connected series of deaths from the transmission of a captured pelisse or other article of dress, that Bonaparte ordered all infected articles to be burnt, causing such great destruction of military appointments as to have led to many remonstrances from the officers. The experience of the British army so entirely coincided with that of the French army as to the contagious nature of fomites, that they adopted the same measures. In the plague of Malta Sir Thomas Maitland conceived that disease to have been introduced into the island of Gozo by a person released from quarantine carrying with him a box he had secured in his garden. The belief in the contagious nature of the plague is so general in the Levant, that persons "shut up" usually encage, send away, or destroy all cats and other domestic animals, which they consider as so many living fomes; and in Malta all articles of food were steeped in water for at least half an hour, the wine was delivered in uncorked bottles, and pigeons, fowls, and rabbits when sold were stripped of their feathers or skin, and every particle of hair, wool, or feathers was removed by pincers and burnt. If the dead body also be considered as a fomes, we find that at Malta the grave-diggers and the bearers of the dead suffered in a very remarkable degree. To remove any doubt that might exist on this head, two criminals that had been condemned to death were placed during the epidemy in Egypt of 1834–35 in the beds of two deceased plague-patients, and they both took the disease.

If the doctrine of the contagious nature of fomites can be considered as proved, it is important to determine what length of time the pestiferous miasmata may be preserved in an active state in the substance they adhere to, and modern experience seems to prove that the period is not long. In Egypt and Syria, the day after St. John's day, when the plague has hardly yet disappeared, the clothes of many thousand persons dead of the disease are openly bought and sold in the market-places without any apprehension of infection. Another strong fact is, that the hospital Esbekié, at Cairo, in which more than 3000 plague-patients had been treated, at the close of the epidemy, and while some plague-patients were still left in it, was appropriated to a different class of patients; and, from some neglect of the servants, these persons slept in the same beds, under the same woollen counterpanes, and with no other change than the blankets, and yet no individual caught the plague. It is singular, also, that immediately after the plague of London, "the houses," says Hodges, "which were before full of the dead, were now inhabited by the living, and the shops, which had been most part of the year shut up, were again opened;" and "many went into beds where persons had died, even before they were cold and cleansed of the stench of the disease," and yet it appears there was no evident extension of the disease. Mr. Tully states, that the experience acquired in the plague of Corfu proved that susceptible effects of all kinds can be securely purified by subjecting them to the combined or even individual action of pure air or water, and that the tents employed in the plague-camps, after being washed half a dozen times in salt water and dried in the sun, were delivered into his majesty's stores, and shortly after employed in the encampment of the garrison. A voyage from Egypt is evidently capable of disinfecting all fomites, for no quarantine officer of Great Britain has been infected with the plague since 1665. It almost seems necessarily to follow, that when the plague is imported into any country, the infection or contagion must be renewed by the sickness or death of some portion of the crew during the voyage.

Susceptibility not exhausted.—Dr. Russel states that at Aleppo he met with 28 cases of re-infection, or 1 in 157; and Clot Bey states that he and his colleagues saw many individuals perish of plague in 1834–35 who had formerly survived an attack of the disease.

Co-exists.—It is certain that neither the syphilitic nor any other poison, as far as is known, gives any exemption from the plague.

Modes of Absorption.—This poison being contagious is necessarily absorbed by the skin, and apparently without breach of surface. Many persons are supposed to have been infected by drinking out of a cup after a person labouring under the disease; and, if so, it must also be absorbed by the mucous membranes. There are good reasons, also, for believing that, being once absorbed, it must infect the blood; for the matter of the bubo is infectious, and blood and bile injected into the veins of dogs have destroyed those animals. Another circumstance also which seems to prove the infection of the blood is that pregnant women attacked with plague almost always abort, and, according to Dr. Russel, some of the children have borne evident marks of the disease; while there is no instance of a child born of a plague woman surviving delivery more than a few hours. Clot Bey, however, inoculated himself, and also many dogs, with blood taken from the heart or large vessels of patients deceased of plague, and these all escaped infection, a result perhaps owing to the extremely minute quantity and diluted state of the poison.

Period of Latency.—The period of latency is a question of great moment in treating of the laws of the plague, as being that circumstance which ought to determine the length of quarantine for the person. Dr. Russel states he has known persons long shut up taken ill almost immediately, or in a day or two after coming out of confinement. Aubert also gives the case of a Maltese who was taken ill on the second day after his arrival at Alexandria. The minimum period of latency, therefore, is short. As to the maximum period, Dr. Russel says, "I met with no instance of the disease discovering itself later than the eighth or ninth day." Aubert and Clot Bey seem to have adopted the same opinion. Father Maurizio extends this period to fifteen days; Sir James M'Grigor to seventeen days; while M. Bertrand, from his observations during the plague at Marseilles, places the extreme period at thirty-five days. It is probable, however, that there must be some error in this last observation, and, consequently, that the extreme periods of latency may safely be stated to be from a few hours to twenty days.

Pathology.—The theory of this disease is, that a poison is absorbed and infects the blood, and after a given period of latency produces certain specific actions, which are either preceded, accompanied, or followed by fever. The more specific actions of the poison are an inflam-

matory state of the brain and its membranes, similar to that of continued fever in this country; also a singular enlargement of the heart, the liver, or of the spleen. But the most constant action of the poison is on the lymphatic system generally,—the cervical, inguinal, axillary, and mesenteric glands being for the most part found enlarged or otherwise inflamed, and thus give rise to the characteristic bubo. The cellular tissue also appears to be often the seat of a specific action of the poison, it being frequently affected with carbuncles; every organ and tissue of the body is likewise covered with petechiæ, and often the seat of hæmorrhagic effusion.

The extreme danger attending posthumous examinations, and the prejudices of the Mohammedans, long prevented our possessing any satisfactory data respecting the pathological phenomena of the plague; but a commission appointed by Mohammed Ali in 1834-35, and consisting of Clot Bey, Gaetani Bey, Lachesi, and subsequently of Bulard, examined the bodies of sixty-eight persons deceased of the plague, and the following is a summary of the results.

On removing the cranium the sinuses were found filled with black blood, the arachnoid veins greatly injected, and the arachnoid cavity often infiltrated with serum, and occasionally with a trifling effusion of black blood. The substance of the brain was generally less consistent than in health, and sprinkled with more bloody spots than usual. The bronchial membrane appeared sensibly inflamed, although during life the patient had presented no catarrhal symptoms. The pericardium frequently contained a reddish serosity. The serous membrane, also, covering the heart and pericardium was often extensively affected with petechiæ. The heart was also distended with blood, and was almost always enlarged, or from a third to a half greater than its natural size; its tissues being often pale, and sometimes softened.

In acute cases the stomach was often natural, but more commonly there was a partial redness of the mucous membrane, like confluent petechiæ; but in more chronic cases it was of a deep red or else of a slate colour. It was also often softened, the seat of superficial ulceration, especially between the folds, and in one case blood was effused. The small intestines, except being the seat of petechiæ, sometimes livid, were rarely found diseased. The ilio-cœcal valve was the only portion of the large intestines found at any time in a morbid state, when its colour was commonly livid, and sometimes ulcerated, the ulcers penetrating occasionally the appendix vermiformis.

The liver was almost always larger than natural, and loaded with blood, while petechial spots were often seen at its surface, and once a sort of pustule was seen on the edge of the right lobe, conceived by some to be a carbuncle. The gall-bladder was the seat of petechiæ, and in two cases blood was effused into the sub-cellular tissue.

The spleen was always twice its natural size, or even more, but was rarely the seat of hæmorrhagic effusion. It was also softened, and deep in colour.

The kidneys were often found immersed in an hæmorrhagic effusion into the surrounding cellular tissue. They were loaded with blood, and the pelves filled with clots. The ureters also occasionally contained blood, and sometimes the lumbar glands were so enlarged as to press upon them and to account for the suppression of urine. The bladder occasionally presented petechiæ, and occasionally the urine was mixed with blood.

Every dissection showed that buboes, wherever seated, always resulted from diseased lymphatic ganglia. These ganglia were always enlarged, and varied in size from an almond to a goose's egg. The least altered were hard and injected. In a more advanced stage, some without any change of colour, and others again as richly coloured as lees of wine, were wholly or partially softened, and some in a state of putrilage. Sometimes these glands became agglomerated and formed masses, some of which weighed two pounds, and around these agglomerations was a hæmorrhagic effusion extending into the cellular tissue. The cervical glands often became so enlarged as to form a sort of chaplet united with those of the axillæ and of the mediastinum. The axillary glands again communicated with the cervical, and with those which surrounded the bronchi. Those in the groin connected themselves in the same manner with those of the abdomen, and these might be traced without interruption through the crural arch into the pelvis and along the vertebral column. It was especially among these latter that sanguineous effusion was found in the sub-peritoneal tissue. The mesenteric glands were often so numerous that the whole of the mesentery seemed covered with them, but they seldom exceeded an almond in size.

The blood, says Clot Bey, is evidently diseased in the plague-patient, although no analysis has shown in what this alteration consists. It is stated never to be buffed; that the serum readily dissolves the colouring matter; and that the lower part of the clot is but feebly coagulated.

Symptoms.—The poison of the plague produces those disordered functions of the great nervous centres which constitute the phenomena of fever, either of a low or of an active character, and sometimes so severe as to destroy the patient in a few hours, and before any secondary actions are set up. "At Aleppo," Dr. Russel says, "in the most destructive forms of the plague the vital principle seems to be suddenly, as it were, extinguished, or else enfeebled to a degree capable only for a short time to resist the violence of the disease; and the form of the plague beyond all others most destructive exists without its characteristic eruptions, or other external marks considered pestilential. These perished sometimes within twenty-four hours."

In milder cases, the fever, of greater or less intensity, is preceded, accompanied, or followed by the secondary actions that have been mentioned. The order of the occurrence of these secondary actions, and the frequency of their accession, is not determined; but buboes, carbuncles, and petechiæ are considered as the characteristic and most frequent symptoms of the plague. Desgenettes thought the symptoms presented three degrees of intensity; so also does Aubert; and this division is also adopted by the *Commission.* The first degree being a slight fever without delirium or buboes; the second degree being fever with delirium and buboes; the third degree, high fever, high delirium, buboes, carbuncles, and petechiæ.

The manner in which the plague attacks is very various. Many instances are given of patients being most suddenly seized, as when conversing, eating, walking, going to bed, or during sleep. Clot Bey, however, thinks cases of this description to be exceedingly rare, more commonly, he says, the disease is preceded for a

greater or less length of time by "lassitude, loss of strength, general uneasiness, and mental anxiety, to which soon succeeded shivering, headache, vertigo, and vomiting; then appear the general and local phenomena, and among them bubo, carbuncles, and petechiæ, preceded or followed by delirium or coma, too often terminating in death."

The *first degree* of the plague is when the symptoms have presented only a slight fever, frontal headache, an altered countenance, nausea, and perhaps vomiting; or should this fever be accompanied by buboes and carbuncles, either simultaneously or consecutively, the buboes always terminate by resolution, suppuration, or induration, while the carbuncles, more or less numerous, are always superficial. In this variety the patient rarely keeps his bed, perspiration is readily excited, and the termination is never fatal. This form is common at the height of the epidemy, and is still more so at the decline of the disease.

In the *second degree* of the plague the patient staggers as in drunkenness, has a stupid air, an injected eye, an embarrassed speech; this is accompanied by nausea or vomiting of bilious matters, and often by diarrhœa, while in the last stage the matters vomited are black. There may or may not be heat of the skin; but the pulse is frequent and concentrated, and the delirium tranquil or agitated. The tongue, at first moist, is often white at the centre and red at the edges and tip, but on the second or third day it becomes dry, black, and chapped at the centre, while the teeth are covered with sordes. The secretion from the kidneys also is affected, the urine being always high coloured, at times sanguinolent, small in quantity, and, towards the termination, often suppressed. From the second to the third day buboes appear in the axilla, groin, or neck, and more rarely in the ham, and about the same time carbuncles and petechiæ, and on the fourth or fifth day, in unfavourable cases, the patient dies comatose. The patient, however, may recover, and the convalescence may be either rapid or prolonged. In the former case, about the fourth or fifth day, the tongue again becomes moist, the skin open, the pulse softer, and the buboes either terminate by resolution, suppuration, or induration; the carbuncles, when they exist, limit their ravages, the petechiæ disappear, and about the sixth or eighth day the patient is convalescent. In cases more severe the black tongue and all the other symptoms continue, the buboes are slow to suppurate, their pus is serous and fœtid, and convalescence is not established till the fourteenth to the twentieth day, and during this protracted struggle the patient often sinks. This is the form of plague which predominates at the height of the epidemy, and gradually disappears as it declines.

In the *third degree* every symptom is increased; the hebetude and dulness is accompanied by an almost entire annihilation of the intellect, and by a prostration of strength so extreme that an upright posture is impossible. The pulse, moreover, is small and frequent, the tongue moist, thick, and purple, the petechiæ of a dark colour, and the patient often dies in 24 or 48 hours, comatose, livid, and without agony. If, however, the disease should be still further prolonged, the pulse rises, the tongue is red and dry, the skin hot, the eye injected, and the countenance animated; and towards the third day an eruption of buboes, and occasionally of carbuncles, follows. The patient has now a chance of recovering, but such a result is rare. It is in this variety that buboes and carbuncles are sometimes altogether wanting; and this is that terrible form which prevails almost exclusively in the first month of the epidemy, and is occasionally met with till its termination.

The bubo seldom maturates till the fever is on the decline, which rarely happens till the eighth or ninth day, nor are they ripe for opening till between the fifteenth and twenty-seventh day. In general, says the Commission, suppuration has not been so frequent as resolution, and never were they seen to be gangrened. Aubert considers the bubo as of good augury for the patient, and its suppuration as the sign of his recovery.

The carbuncle is by no means of constant occurrence, Dr. Russel having found it only in 490 cases out of 2700. It appears, says Clot Bey, more commonly in the middle or towards the decline of the disease. Hardly any external part is free from them, not even the penis, and in one instance a carbuncle formed in the throat, which was fatal. They occur more particularly on the limbs, and more especially on the legs. In some cases they form on the cheek or lips, and by the tumefaction they cause give to the face a hideous aspect; in others the whole of one side of the jaw has been laid bare, while in others they have formed on the eyebrow and on the eyelid, and partly destroyed the eye. Clot Bey, however, observed they never formed on the scalp, the palms of the hands, or on the soles of the feet.

According to Clot Bey there are three different varieties, and all commence in the same way, or by a small red pimple, which increases, and in the centre of which a vesicle forms, containing first a yellow and afterwards a blackish serum. In the most benign the vesicle bursts and dries up in three or four days from its first formation, the epidermis alone having been infected. The second variety involves the whole thickness of the skin, as well as portions of the cellular tissue, which is moderately tumefied, and surrounded by a dark red areola. The gangrene in this form is circumscribed, and there results an eschar from one to two inches in diameter, which is detached by suppuration, leaving an ulcer with a sharp perpendicular edge. In the severe forms the redness and tumefaction cover a large space, and the gangrene rapidly involves the skin, the cellular tissue, and sometimes even the bones. It has been observed that the malignity of the carbuncle is in the direct ratio of the severity of the disease, but their mere existence is not of unfavourable augury. Their number is very various, sometimes only one, at others ten or twelve, and Clot Bey gives a case in which more than thirty formed on the thigh and leg, but they were all benign. When there are several they often form in succession. These tumors are often very painful, and Aubert mentions one seated on the back of an Arab soldier four inches in diameter.

Petechiæ are observed in some seasons and not in others. They present their different shades of colour according to the intensity of the disease, or rose-colour, violet-colour, or black. Aubert considered their appearance an almost certain sign of death. The duration of this disease is from a few hours to 15, 20, 30, or even more days.

Diagnosis.—Clot Bey says the diseases which most resemble the plague are typhus, severe forms of paludal fever, apoplexy, dysentery, parotiditis, and scrofulous or syphilitic affections of the ganglionary system.

Prognosis.—Desgenettes calculated that not more than one-third of the French soldiers attacked with plague

recovered. In the plague of Marseilles 40,000 are said to have died out of a population of 90,000. At Malta, dividing the months of July, August, and September into two equal parts, 90 in 100 cases died in in the first half, and 60 in 100 cases in the second half. At Alexandria, in 1834-5, out of a population of 42,000 persons, 14,000 are supposed to have perished. Clot Bey estimates the whole mortality for Egypt in that year to be as one in three of those attacked.

Many instances are given of a patient apparently convalescent, and even walking about, dropping down and expiring; but in general, says Clot Bey, cyanosis and partial coldness of the extremities, petechiæ, and the subsidence of the buboes were the grave symptoms. Pregnant women always aborted when seized with the plague, and all those near their time invariably died, and that even when the loss of blood has been inconsiderable.

The favourable symptoms are a quick re-action, abundant sweats, and the suppuration of the buboes.

Treatment.—In the treatment of the plague neither the practice of the French or English medical officers serving in Egypt has led to any happy result. The French first tried rubbing the body with oil in the manner so strongly recommended by Prosper Alpinus, but their frictions only added to the anxiety and apprehensions under which the patient laboured. Cold affusion was then tried, but it caused hæmorrhage; mercury produced diarrhœa; to scarification succeeded gangrene; and to actual cautery increased debility. Bleeding was likewise tried, but was altogether unsuccessful, so that the French medical officers, baffled in every attempt at heroic treatment, at length confined themselves to watching the disease and palliating symptoms, giving antimony on the accession of the fever, and opium in diarrhœa, while they supported the patient afterwards by camphor, æther, bark, or wine.

In the British army a variety of similar or other modes of treatment were tried, but with an equal want of success. Dr. Whyte relied on the lancet, but every one of his patients are stated to have died. Some gentlemen attached to the Brunonian treatment, kept their patients under the influence of wine and opium, but this practice was so little successful that it was abandoned. Mercury and nitric acid were thought more favourably of, but mercury was only useful when it affected the mouth, and it was a general remark that the gums were unusually insensible to the action of this mineral in the plague.

It is to be regretted that recent experience has not in any degree advanced the successful treatment of the plague. "In the beginning of the epidemy," says Clot Bey, "when the morbid cause acts with a rapidity so great that some hours are sufficient to compromise the life of the patient, every treatment, even the most energetic, is powerless to arrest the course of the disease. When, however, the intensity of the disease abates we may hope for the recovery of the patient." Many will attribute this happy recovery to nature, but it can hardly be denied that nature may be greatly assisted by art. But what are the means to be adopted? This question is most embarrassing, for, consult 20 different practitioners, and each will recommend a different treatment. One relies, for instance, on narcotics, another on stimulants, a third is the exclusive partisan of bleeding, while a fourth cures all his patients by purging, or vomiting, or both. The *Commission* state, "We believe every therapeutic means to have been absolutely useless in the plague, but that under the antiphlogistic treatment the largest number recovered."

The treatment of the *bubo* was first attempted by actual cautery or a blister, but the *Commission* appear to have abandoned this mode of treatment, and to have applied emollient poultices as a mode of favouring suppuration and of mitigating pain. As soon as matter was formed they immediately opened the tumor.

The treatment of the *carbuncle*, when benign, was also by poultices. If, however, the slough was deep the part was cauterized down to the living flesh. When the mortification was of great extent, a circular incision was made in the integuments immediately round the tumor, and an iron heated to a white heat was introduced into the furrow. The subsequent dressing was lint steeped in the chlorides, and when the part granulated up it was then dressed with a compress.

Dietetic Treatment.—The diet to be observed in the cure of the plague is very imperfectly laid down by the different writers who have treated on the subject; but no doubt it must be the same as that observed in other febrile disorders, or that the patient should rigidly abstain from all animal food and limit himself to slops and a strictly vegetable diet.

Preventative Treatment.—The preventative treatment may be divided into the measures necessary for the protection of the attendants on the patient; into those which are necessary to prevent the introduction of the plague into any given city; and lastly, into those which should be adopted supposing that disease to have broken out in any town, city, or camp.

The only mode of preventing personal contamination is for the attendants on the sick to clothe themselves in oil-skin dresses, and to avoid all direct contact with the patient or with any article, whether of linen or of any other kind, that he may have touched, or which has been in any way in contact with his person. The atmosphere of a plague hospital was found, both at Malta and at Cephalonia, to be so little noxious that the attendants slept in the wards with impunity, provided they secured themselves from all personal contact.

As to preventing the introduction of the plague into any city to which it is not native, it must be admitted there is no other safeguard than quarantine, and the length of the quarantine should be the longest period of latency, *plus* the time it takes to overhaul the cargo. The longest period determined by Sir James M'Grigor for the latency of the poison is 17 days, while the time taken to unload the cargo may be estimated about four to six days, making the longest necessary period of quarantine to be 21, or at most 24 days.

When the plague has broken out in any city, experience has shown that no half measures are of any avail; that there is no middle course between allowing the disease to take its course and adopting the complete system of isolation followed in Malta in 1813. The mode in which this was effected is as follows: On proclamation of the plague existing, the gates of the town were shut, public business of every kind suspended, the population required to repair to their respective homes, and no person was now allowed to move out except especially employed on the public business. After this the town was divided into small districts (at Valetta there were 24), and a corps of volunteer guards was organized, by the inspector-general of the police, out of the inhabitants. The duty of this corps was, not to move

out of their own streets, but to do duty at the doors and windows of their own houses, and thus to prevent all improper communication, and to see that all susceptible articles of food were immersed for half an hour at least in water; that pigeons, rabbits, and fowls were stripped of their feathers and skins; that wine was received in clean uncorked bottles; that all susceptible articles were carefully examined, and all filaments of wool, thread, feathers, &c., removed, by pincers and burnt; that all coins were passed through vinegar; and that all contact with porters, carriers of provisions, or other persons, was carefully avoided. Besides these guards, one deputy and one clerk were appointed to each district, and such a number of sick-searchers and police serjeants as might be required. The duty of the deputy, with the aid of his clerk, was to make out an accurate return of the whole population within his district, and to take care that at the door of each house a list of all persons residing there was affixed, and which list was to be corrected weekly, and a copy thereof regularly transmitted to the inspector-general. It was also the duty of the deputy to call forth the inhabitants of such houses to see that they were in perfect health, and to make a report every three days where no case of sickness occurred, but when such case did occur to make his report instantly to the inspector-general, who was to communicate the intelligence to the proto-medico, that necessary measures might be taken for ascertaining the nature of the complaint. If the disease on investigation was declared to be the plague, the parties infected and the parties suspected were equally sent to the lazaretto, taking with them such articles of value or of furniture as they might wish to save; and the moment they were removed the whitewashers and expurgators, preceded by beat of drum and sound of bugle, so as to warn all parties of their approach, marched to purify, expurgate, and to whitewash the infected house; and in order that there might be no concealment, it was ordered that on no account whatever should a corpse be interred without an antecedent medical examination directed by the proto-medico.

It is hardly possible to conceive that any community, unless strongly persuaded of the contagious nature of the plague, could submit to a system of discipline so severe, and which can be regarded as an evil only inferior to the plague itself.

When the army was in Egypt a minute inspection was made of every corps and of every department twice a week, and any person with the smallest appearance of ill-health was sent to the hospital; also every corps or hospital where a case of plague had appeared was put into a state of quarantine, and of such corps an inspection was made by the surgeons at least two or three times a day, and every case with suspicious symptoms was ordered to the observation tent or room, and on the plague appearing, such case was immediately sent to the pest-house. The men were likewise ordered to bathe frequently, and their clothes and bedding to be frequently washed and baked, while the quarters of the army were frequently changed.

Such are the preservative measures which have been raised as a barrier against the introduction of the plague into Christian Europe. "The dread of contagion," says Dr. Russel, "neither can nor ought to be eradicated from the mind of man."

Of the Poison of Farcinoma.

The horse, the ass, and the mule are liable to a disease termed the glanders; it occurs under two forms, or the glanders and the farcy. Many veterinists have considered these varieties to be distinct diseases, but numerous experiments have demonstrated that they have their origin in one common animal poison. It appears, however, that there are several grades or varieties of both these diseases. Thus, if glanders be defined to be a fever with a running of matter from the nose, farriers distinguish three kinds: one consists of ecchymosis and gangrene, principally of the pituitary, tracheal, or bronchial membrane; another of a pustular eruption of the same parts followed by ulceration; while a third is a combination of these two forms of disease. Of farcy also there are two kinds, or the *bud farcy* and the *button farcy*. The bud farcy consists in the formation of a number of tumors on different parts of the body, as on the head, neck, and extremities, and particularly on the hinder ones, these tumors being formed not only by enlargement and inflammation of the glands, but also of the cellular tissue, and which, at the end of four or five days, soften and ulcerate. Similar tumors are said to form also in the substance of the pituitary membrane, which quickly suppurate and cause death. The button farcy is an inflammation limited to the lymphatic glands and vessels, without involving in any considerable degree the cellular tissue. It usually commences in the hinder extremities, causing lameness and enlargement of the limb; and when the valves of the lymphatics become thickened it forms a tumor called the "farcy bud," while, if the lymphatic vessel itself be inflamed, it is termed "farcy pipe."

The affections which have been mentioned have been supposed to be peculiar to the monodactyles; but it has been determined by a number of severe accidents occurring to persons employed about glandered horses, that the poison producing them is capable of being transmitted from the horse to the human subject, and again from the human subject to the horse, and to the ass, and there is reason also to believe that it is capable of being transmitted from one human being to another. The attention of the profession was first called to this interesting subject by Mr. Muscroft, in the Edinburgh Medical and Surgical Journal, in the year 1821, where he relates the case of the whipper-in of the Bardworth hunt, who wounded himself in cutting up a glandered horse for the kennel, and died at the end of a week of confirmed glanders; and two similar cases appeared in the same work about two years afterwards. These cases excited but little notice till Mr. Travers published his valuable work on Constitutional Irritation, in 1828, containing a letter from Professor Coleman on the transmission of glanders from the horse to man, and from man to the ass, together with some other cases which had fallen under his own observation. The subject was now followed up by Dr. Elliotson, in two papers in the Transactions of the Medical Chirurgical Society, narrating three cases which had occurred in his own, Dr. Roots's, and Dr. Williams's practice. At length all the then known facts were collected in an elaborate paper by Rayer, in the sixth volume of the Mémoires de l'Académie Royale de Médecine.

Remote Cause.—The remote cause of glanders in the horse is but little understood, but it is probably an atmospheric poison, having a peculiar affinity for the horse, and animals of his class. The glanders, however,

when they affect the human subject, have in all instances been distinctly traced to the glandered horse as their remote cause, for no instance is known of their occurring primarily in man.

Predisposing Causes.—In the horse certain predisposing causes greatly favour, and are perhaps necessary to the spread of the glanders, as dirty, close, ill-ventilated stables, especially if the situation be low and damp. Horses also, when crowded on board transports, are greatly liable to this affection. Thus the Arab, in transporting his horses from Arabia to India, always chooses that part of the year when the passage is shortest, lest the accidents incident to a long voyage might oblige the hatches to be closed, and want of ventilation give rise to glanders. Bad food is also a powerful predisposing cause in the horse, especially when these animals are picketed on service, and thus exposed to the inclemency of the weather. At the close of a campaign the cavalry is often decimated by this disease, and towards the termination of the Peninsular war, the losses from this cause are said to have been enormous. The cases occurring in the human subject are too few to allow of any inference being drawn as to the influence of the predisposing causes in the production of the glanders, but they have all occurred in young men, and probably a close investigation would have shown that the habits of the patient were such as to fall within those laws which favour the production of the disease in the horse.

Contagious.—The general facts which establish this law in the horse are, that an immense majority of veterinary surgeons, of stable-keepers, and coach-proprietors, believe in this doctrine, and everybody must have heard this class of persons complaining, if a glandered horse has been introduced into their stables, that their stock has almost immediately fallen ill of the disease. There are few districts also in which some farmer, by the loss of a considerable part of his team, has not had sufficient proof of the contagious nature of the glanders. In this country the law is severe against offering for sale, or even working, a glandered horse, which shows that the opinion of our ancestors, time out of mind, has been that the glanders are a contagious and a fatal disease. In Germany the belief of contagion is so general that it is said the law directs any horse that has been in contact with a glandered animal shall be immediately killed. Again, Professor Coleman has produced the glanders by direct inoculation from horse to horse, so also have Professors Peal and Renault, while Leblanc assures us that he has repeated these experiments till he has demonstrated, that not only are the glanders contagious, but that the farcy and glanders are mere varieties of the same disease, the farcy matter producing glanders, and the matter of the glanders farcy.

Cases of the transmission of the glanders from the horse to man are now numerous; and that the disease is actually the glanders has been shown by Professor Coleman, who directed two asses to be inoculated with matter taken from the arm of a Mr. Turner then labouring under this disease, consequent on a puncture received in dissecting a glandered animal, and both animals died of the glanders. These experiments have been repeated with similar results by Gerard, Hering of Stuttgardt, and more recently by Leblanc, with matter taken from a patient that died glandered under Rayer, so that no doubt can exist of the fact. It seems proved, therefore, that the glanders are transmissible from the horse to man, and again from man to the ass. It has been contended also, if the glanders are transmissible from man to animals, they must be capable of being communicated from one human subject to another, and a case of this description appears actually to have occurred in St. Bartholomew's Hospital only a few months ago, when the nurse, a healthy woman, contracted the disease from a patient in the ward, and, after a short illness, died with every symptom of the glanders.

Fomites.—The fact of repeated inoculation with glandered virus distinctly shows that fomites may be so infected as to produce the disease. The spread of the disease also has been attributed to healthy horses having drunk out of the same pail or trough with a glandered horse, or to licking the neighbouring rack or partitions of the stalls in which a glandered horse had been placed. Mr. White attributes the occurrence of the glanders in a mare and two foals to some hay which had been left by a team of glandered horses being blown into their paddock.

Susceptibility exhausted.—The great fatality which has attended this disease has rendered it impossible to illustrate this law.

Co-exists.—The number of cases of glanders which have occurred in the human subject are as yet too few to throw any light on this law.

Modes of Absorption.—The farcinomatous poison has been introduced into the system both by the cutaneous and mucous tissues. Thus glanders have been produced by inserting the virus under the cutis with a lancet, and by rubbing it on the greasy heel of a horse; they have also been produced by inoculating the mucous membrane of the nose of the horse, or else by smearing that membrane with farcied matter. Farcied matter has also been made up into balls, and introduced into the stomach of the horse, and glanders have resulted. There can be no doubt, therefore, that the poison is absorbed both by the cutaneous and mucous tissues, and that being absorbed it infects the blood. This latter fact has been distinctly proved by Professor Coleman, "I have," says this gentleman, "produced the disease first by removing the healthy blood from an ass, until the animal was nearly exhausted, and then transferring from a glandered horse blood from the carotid artery into the jugular vein of the ass. The glanders in the ass was rapid and violent in degree, and from this animal, by inoculation, I afterwards produced both glanders and farcy. In acute glanders, therefore, the blood is undoubtedly affected."

Period of Latency.—The poison of the glanders has its period of latency, like all other morbid poisons, and that period is in general short. Two asses were inoculated by Mr. Turner, the one about a year, and the other a year and a half old, and in the first the maxillary glands became tender on the second day, and the discharge from the nostrils was established on the third. In the other the maxillary gland enlarged on the third day, but the discharge from the nostrils did not take place till the sixth day. Sometimes, however, the incubation is much longer. In the procès-verbal de l'Ecole de Lyon, a case is given of a horse which was inoculated with farcy matter, but the disease did not appear till the end of three months, and then precisely at the points of puncture. M. Gerard, an ex-veterinary surgeon of the French "artillerie de la garde," states that he introduced the matter of the discharge every

day, into the nostrils of certain horses by means of a brush, and that the disease appeared in one on the seventh day, but in two others not till the 32nd day.

In the human subject, the poison has in general been latent from two to eight days after the accident of the puncture.

Pathology.—The theory of this disease is, that a poison is absorbed and infects the blood, and after a given period of latency produces in slight cases an abscess at the point of puncture, followed by some tumors in the course of the absorbents connected with the punctured part. In severe cases fever is previously set up, and after this has continued for some days, there follows either a diffuse or an eruptive inflammation of the mucous membrane of the nostrils and of the trachea, terminating in suppuration, ulceration, or gangrene; also some inflammatory affection of the lung, together with the usual farcy button or bud tumors in different parts of the body.

In the cases collected by Rayer, the nose and nasal fossæ had only been examined in four cases out of fifteen, and in these there was found either ecchymosis, ulceration, or gangrene of the mucous membrane of the septum nasi, or else granules in the sinuses. The mucous membrane of the larynx, or trachea, has likewise been found studded either with the peculiar eruption, or else diffusely inflamed or ulcerated, so much so that in one case the epiglottis was in part destroyed. The lungs have likewise been found either gorged with blood, or else the seat of lobular pneumonia, or of vomicæ. In Dr. Roots's case there was an encysted abscess of the lung, which contained about two ounces of pus. Besides these affections of the more vital organs, a number of small farcy tumors have been found in different parts of the trunk, and extremities, and perfectly remote from the point originally punctured. These tumors are in different states of inflammation, some being white and indurated, others soft and injected, and others in a state of suppuration. In Dr. Roots's case, an abscess on the back of the hand communicated with the articulation of the metacarpal bones; and in another case an abscess had opened into the knee-joint. The absorbent vessels have likewise been found inflamed along the arm, from the point of puncture, and the glands to which they lead have been found enlarged and indurated, or in a state of suppuration.

Symptoms.—The glanders may be either acute or chronic. Acute glanders consist of primary fever, followed by local inflammation. Chronic glanders are when the local inflammation exists *per se*. The proportionate number of cases of each kind is not determined.

Acute glanders are ushered in by an attack of primary fever, with or without rigors. This is followed by pains in the limbs so severe as often to be mistaken for an attack of acute rheumatism. Some days after, the pained parts become the seat of phlegmonous tumors, accompanied with much pain, redness, and tenderness; these more commonly terminate in abscess, sometimes discharging a laudable pus, but more usually a bloody sanies, and rapidly become gangrenous. Towards the close of the disease, in 11 out of 15 cases, there has been a discharge of matter more or less purulent, viscid, and mixed with blood, from the nostrils, and in 10 of these cases the discharge was from both nostrils. The quantity, however, has in general been inconsiderable, and sometimes scarcely appreciable. The period at which this symptom appears is not constant, for it has been seen as early as the 4th, and as late as the 16th day. In the course of the disease, also, the eyelids are generally tumefied, and discharge a thick viscid matter, like that from the nose, and an enlargement of the submaxillary gland has been seen in one case.

One of the most remarkable symptoms of acute glanders in man, is the eruption of pustules on the face, trunk, limbs, and genital organs. This eruption has been compared to the varicellæ, to the small pox, and to ecthyma, but in fact is *sui generis*, and cannot be compared to any other. It has been observed to occur about the 12th day, and to be preceded and accompanied by profuse fœtid sweats. Besides this eruption, a number of black bullæ have been observed on the nose, forehead, below the ears, on the fingers, toes, and genital organs, and these have been followed by gangrene, more or less extensive and deep.

The pulse is full and quick in the early stages, but towards the close becomes rapid, small, irregular, and even intermittent. The tongue varies, as in typhus, being first white and coated, and subsequently brown or black. Diarrhœa and meteorism often complicate the disease, and black blood has been observed in the stools.

Cerebral disturbance has come on as early as the second day, but more commonly not till towards the tenth; sometimes marked by a singular want of intelligence, at others by a sinister presentiment, followed by stupor and death.

Acute glanders are rapid in their course, and two thirds of the cases have terminated before the 17th day; two have died on the 21st day, one on the 28th day, and only one has survived till the 59th day.

Chronic glanders, or acute farcy, differs from acute glanders, in the circumstance of the local lesion preceding the general febrile derangement; the introduction of the poison being followed in a few hours by inflammation of the lymphatics, proceeding from the wounded part, and extending sometimes to the elbow or axilla, and involving the axillary glands. This is followed by inflammation, and extensive abscesses in the sub-cutaneous cellular tissue, often involving the whole limb. From this state the patient may recover; but should they be multiplied over various parts of the body, and accompanied either by the pustular or gangrenous vesicular eruptions, or both, the result is generally fatal, for hectic symptoms supervene and hasten the final catastrophe.

The disease has terminated in a fortnight, more commonly has not proved fatal till the end of a month, and in cases still more chronic, a twelvemonth has been known to elapse before the patient finally recovered, or else died. Such are the general symptoms of acute and chronic glanders, as they have been observed in the human subject.

Prognosis.—Of 15 cases of acute glanders collected by Rayer only one recovered. Of 15 cases of acute farcy only five recovered. Of seven cases of chronic farcy only one died. Of the three cases of chronic glanders two died. The only favourable prognosis consequently is in chronic farcy.

Diagnosis.—"Acute glanders," says Rayer, "cannot be confounded with poisoning from puncture in dissecting or opening dead bodies;" for he adds, "out of 50 such cases reported by various authors, no mention is made in them of a discharge from the nostrils, or of a nasal or laryngeal eruption being found after death, or of

the peculiar cutaneous eruption." Leblanc also states that he has inoculated the horse with a great number of other morbid secretions from the human subject, but has in no instance produced any disease similar to the glanders. It may for a short time be mistaken for rheumatism, but the occurrence of the secondary actions quickly dispels this error. It is perhaps impossible to enumerate every difficulty that may occur in the diagnosis, but when any doubt exists, an inquiry into the habits and employment of the party will probably solve the problem; or the inoculation of a healthy animal is an excellent counter-proof.

Treatment.—All the remedies hitherto tried in acute glanders have failed, for only one out of 15 has recovered, and that not from any particular treatment. Blood, when taken at the commencement, has been found buffed, and some momentary relief has been afforded, but prostration and stupor have quickly followed, while leech-bites have become gangrenous. The coming on of typhoid symptoms has caused quina, valerian, serpentaria, ammonia, and other stimulating medicines to be exhibited, but all these medicines have failed. Vomiting and purging have likewise been had recourse to; but these measures have been equally unsuccessful. It is probable, therefore, that the cure of this disease depends on the discovery of a specific remedy, and every experiment in treatment is warranted as the only chance of subduing a malady which has so constantly proved fatal. In the more chronic forms of the disease, the recovery of the patient has appeared to be owing to the excellence of his constitution, and to a generous diet, rather than to any powerful effect produced either by general or local treatment.

Preventative Treatment.—The prophylactic treatment is the same as that of all other contagious diseases, or carefully to avoid all contact with the morbid poison, and especially when a finger or other part of the hand is abraded; and if by accident the veterinary surgeon should inoculate himself, he ought instantly to touch the part with lunar caustic. It has been recommended, after the disease is set up, to extirpate the enlarged glands; but if there is any truth in the doctrine that the blood is poisoned in this disease, and that the local affections are the secondary actions of the poison, this practice must be as unwarranted as hopeless.

Of the Poison of Cellulitis Venenata.

Cellulitis Venenata is that disease which occasionally affects the anatomist from punctures received in dissection, and also butchers, farriers, and cooks, in the prosecution of their business, in consequence of the dead animals with which they are conversant sometimes being in a morbid or poisonous state. This poison, however generated, being absorbed, produces inflammation, not only of the cellular tissue of the punctured limb, but often also of some remote part, as of the opposite side or arm. Dr. Collis was perhaps the first to draw the attention of the profession to this interesting subject, by the relation of two fatal cases, in the third volume of the Dublin Hospital Reports. This example has been followed by Dr. Duncan, jun., by Mr. Travers, and by Mr. Stafford. The facts thus obtained are not numerous, but are sufficient to enable us to give a slight sketch of the probable laws of this poison.

Remote Cause.—The remote cause is the deceased human body, or the dead body of some animal—the persons attacked, and the phenomena of the disease, plainly demonstrating such bodies, in a given number of cases, to be poisonous. It is admitted, for instance, that medical men and medical students are liable to this disease in a much larger proportion than other classes of persons; and also, that they are liable to it only while they are prosecuting their professional duties or studies. It is therefore fair to infer, that as they can cut or wound themselves with impunity at other times, that the instrument with which the puncture has been inflicted must be armed with some deleterious agent. It is not determined, however, whether this agent is always the same; also, whether it is the product of animal decomposition, or generated during the disease of which the patient has died.

There is one circumstance, however, which seems to demonstrate a given specific poison, and not a plurality of poisons, which is, that the same phenomena result, or nearly so, after the examination of bodies of patients who have died of the most opposite diseases. In Professor Dease's case, for example, the patient had died from pulmonary consumption; in Mr. Higginbottom's, of typhus. The patient examined by Mr. Blythe and Mr. Young had died of hydrothorax; while Dr. Dease and Mr. Newby were infected by opening the bodies of patients who had died of enteritis. Mr. Burton died from examining an aneurismal sac; and Dr. Kelly, Dr. Andrews, and Mr. C. Cheyne, of Leith, were all infected, in various degrees, after having been engaged in the examination of a patient on whom the Cæsarian operation had been performed.

It is usually considered that animal matter, far advanced in a state of putridity, is the cause of this disease; but experience has shown that an advanced state of putrefaction is a protection to the anatomist, and that the greatest danger is to be feared from a recently dead body; as proof of this law, the disease was contracted by Mr. Archer, a dresser of Guy's Hospital, in consequence of his examining the body of a patient who had died only the day before, and that in the depth of winter, or on the 11th of February. Mr. Dean was infected by the body of a woman who had died only forty-eight hours before, and also in February. The patient examined by Dr. Pitt had been dead about the same time, and the examination was made at Christmas. Mr. Delph and Mr. Smart were infected May 11th, by the body of a woman who had died the same morning, and was still warm; and Mrs. Hodges was infected in consequence of hanging up a piece of fresh meat. It is plain, from these instances, that the time which had elapsed from the death of the patient till the examination of the body was too short, and the temperature of the time of year too cold, to allow of rapid putrefaction.

The intimate nature of this poison is entirely unknown, and it has been stated it is questionable whether it be formed in the last moments of life, or is a product of incipient decomposition. It would appear that some bodies are more apt to generate it than others, a given body often infecting two or more persons, who have been in the habit of making posthumous examinations for years with impunity. Thus one body communicated the disease to Professor Dease and Mr. Egan; another to Mr. Hervey and Dr. Hennen, jun., and in a slight degree also to Dr. Dumbreck; another to Mr. Young and Mr. Blythe; and another to Mr. Cumming and Mr. Blythe, all persons continually practised in dissection.

Some parts of the body also appear to communicate this dangerous disease more rapidly than others. The brain of the recently dead body is supposed to be extremely apt to produce it. The sero-purulent fluid also found in the larger cavities is also greatly infectious. But the most dangerous animal fluid is that contained in the abdomen after puerperal peritonitis; and also the serum found in diffuse or gangrenous inflammation. The white cancer of the liver and the substance of other medullary tumors is said to be greatly irritating. The dead bodies of animals are much less infectious than those of the human subject; nevertheless, persons who clean tripe, and horse-knackers, are said to be subject to inflammation of the hands.

It is probable that in all cases a puncture or abrasion is necessary to the absorption of this poison; but sometimes the wound is so trifling that the party infected is not aware of it, nor is any trace of it distinguishable at the time the disease is set up.

Predisposing Causes.—The infected person has frequently been in a state of impaired health at the time of receiving the injury, or else in a state of health, however inexplicable, which predisposes him to the action of the poison, for hundreds of punctures are inflicted with impunity for one that endangers life; and it has often happened that two persons out of three examining the same dead body have escaped, although they have received similar punctures with the suffering party. In general, indeed, the punctures, although the lancet be poisoned, are not followed by any serious accident in the strong and robust, the punctured part only slightly inflaming, festering, or becoming the seat of a small phlegmonous abscess. When the student, however, is of a feeble constitution—weakened by hard study, excess, or previous disease,—his liability is greatly increased, and the disease may assume a fearful character. The spring is supposed to be the season at which the greatest numbers are attacked.

Contagious.—No case is known of the transmission of this disease from one living person to another.

Susceptibility exhausted.—Some persons repeatedly suffer from wounds received in dissection. It is probable, therefore, the susceptibility to this poison is never exhausted.

Co-exists.—There is no given state of the body known to give exemption to the action of this poison.

Modes of Absorption.—After the examples that have been given, no question can exist about the cutaneous tissue absorbing this poison. Gaspard and Majendie have also shown that putrid matters, whether injected into the cellular tissue of the groin of an animal, or into its veins, equally produce the death of the animal subjected to the experiment. This poison, therefore, probably infects the blood.

Period of Latency.—The period of latency of this poison is unusually short. Thus, Mr. Elcock punctured his finger on opening a patient at twelve o'clock, and it became so painful that he showed it to Sir Astley Cooper the same evening. Dr. Pitt examined his patient at eight o'clock in the morning, and in the evening of the same day he complained of uneasiness in the punctured part. In Mr. Percival's, and also Professor Dease's case, the local symptoms were only delayed till the following morning. A longer instance of latency occurred in Mr. Newby; this gentleman opened the body of a child that had died of enteritis on Sunday, but it was not till Wednesday evening that he was laid under the full influence of this fatal poison, which in a few days destroyed him. The longest period of latency is that recorded by Dr. Spurgin, of a cook-maid, who had been practising on a stale hare, to learn the method of boning it; and a few days elapsed in this case when two slight scratches, which she remembered to have received at the time, began to inflame, and a long and severe disease followed.

Pathology.—The theory of this disease is, that a poison is absorbed and infects the blood, and after a short period of latency usually occasions only inflammation of the wounded part. In other cases, however, in addition to the local inflammation, a severe form of fever is added, with extreme prostration and coated tongue, and as the disease proceeds, abscesses are often formed in various parts of the body, sometimes remote from the original wound. The poison, therefore, acts locally on the punctured limb, on the cellular tissue generally, and also on the great nervous centres, producing the phenomena of fever.

After the death of the patient, in such few instances as have been examined, the cellular tissue has been found variously inflamed, the parts affected being loaded with serum in one part, with pus in another, and in a third gangrened, while the abscesses usually contain much sphacelated cellular tissue. The muscular fibre beneath the affected part has been found softened and more readily torn than usual; and in one case quoted by Dr. Duncan, both layers of the intercostal muscles were destroyed, and the ribs denuded. In some instances the muscular fibres are paler than usual, and in others darker. These phenomena have been found in whatever part the abscess may have been situated.

The axillary glands are usually enlarged and imbedded in a highly diseased cellular structure; "but although a swollen and tender state of the axillary region is one of the first symptoms observed, I have never found," says Dr. Duncan, "the glands so much diseased as to support the idea that they were the primary cause of the surrounding inflammation." The pathological states of the brain are not yet satisfactorily determined.

Symptoms.—Cellulitis venenata has many grades, so that it may be divided into cellulitis venenata mitior, and cellulitis venenata gravior.

In the milder forms of the disease, the wound, usually on the back or palm of the hand, or on the fingers, inflames, an ill-defined but general swelling of the finger or the whole hand follows, and this sometimes extends up the arm as high as the elbow, accompanied with a throbbing pain, and an inflamed state of the lymphatics. In severe cases the inflammation extends still higher, or to the axillary glands, so that the whole limb is more or less affected. This inflammation is commonly seated in the cellular membrane, external to the fascia, and also in the sub-fascial cellular tissue. In slight and ordinary cases it terminates in effusion of serum, which being absorbed, the disease subsides; the patient suffering, perhaps, for a few hours from a slight attack of secondary fever.

In severe forms of the disease, the inflammation spreads from the arm or axilla to the trunk of the body, as in Dr. Pitt's case, without leaving any sound interspace. The most alarming variety, however, is when the local injury heals, or only a slight inflammation, as a vesicle or pustule, forms at the point of puncture, the severe inflammation attacking some remote part, as

above the elbow, or the axilla of the same side, whence the inflammation extends over the neck, perhaps down the sternum to the ilium, or even to the middle of the thigh, as in Professor Dease's case. In most cases these extensive inflammations have been limited to the same side by the mesial line, and only in a few instances has it passed that boundary. In other instances, as in Mr. Dease's case, the disease commenced in the left axilla, and passed to the right fore arm; and in Mr. Cumming's case it began in the left axilla, and passed to the right, where it terminated in gangrene.

The abscess which forms in the more dangerous cases is always diffuse, has no tendency to point, and is only slightly elevated above the surrounding parts, while its limits are rarely defined by a margin. Its elasticity is something between emphysema and œdema, and has been termed boggy or quaggy. If the glands likewise should be enlarged, it is only slight in degree, while no lymphatic vessel can be traced to them.

In these bad cases the inflammation runs its course, and terminates in extensive suppuration, without any redness of the skin, and perhaps in all cases the cutaneous inflammation is secondary, and consequent on the inflammation of the cellular tissue.

The pain in the swollen part is generally exquisite. In Mr. Hutcheson's case it was his chief complaint, even while there was yet neither discoloration or phlegmon. In Mr. Dease's case the pain also preceded the redness, and was almost intolerable. Dr. Pitt suffered so much as to have observed, he had never before known what pain was; and in Mr. Clifton's case it amounted to torture.

Such are the local symptoms. In a few cases the local disease is preceded a few hours by primary fever; but in the majority of cases the local disease is first set up, and the fever, consequently, is secondary; but in these latter cases the fever has often run high, and endangered the life of the patient before the local inflammation has been clearly developed. In every case the fever is typhoid in character, with great prostration of strength and profound depression of spirits. In general, however, the mind is collected and the delirium inconsiderable, or occurs only at night, or towards the close of existence. Still, there are a few cases in which it commences early, is violent, and continues throughout the disease. In several instances the skin, so far from being hotter than usual, has been sensibly colder; while the perspiration has been sometimes so fœtid as to be hardly bearable.

Diagnosis.—This disease is distinguished from typhus by the local affection, and from erysipelas, by the history of the case, and the existence of the intense pain.

Prognosis.—The great majority of these cases are slight, and are hardly a source of anxiety. In the severer forms of the disease, as a general rule, all recover when the inflammation is limited to the lower arm, and does not terminate in gangrene. A slight inflammation, also, of the absorbents and their glands is also often recovered from. On the contrary, few survive when the axilla is the principal seat of the disease, without any obvious connexion with the punctured part.

Treatment.—When cellulitis venenata has been of such severity as to merit a record of the case, it would appear, all theory apart, that whatever has been the mode of treatment, one-half have recovered and one-half the patients, or nearly so, have died. In the cases recorded by Dr. Duncan, jun., of Mr. Blythe and of Mr. Young, each treated as nearly similar as possible, the one died and the other recovered. Of eight cases that were bled or leeched, or underwent both operations, four died, and among them Mr. Cumming, who was bled four times from the arm, and had four dozen leeches applied. In the cases reported by Mr. Travers, Professor Dease was bled to twenty ounces, and had 100 leeches applied to the shoulder, and yet he died; while Mr. Clifton, who was bled to a still greater amount, recovered. Eight other cases are recorded that were treated by antiphlogistic medicines, by leeches, and by poultices, and of these four died and four recovered. Of two treated by tonics, one died and one recovered; while in Dr. Pitt's case the treatment was complex, and he died. It should also be added, that in almost every case calomel was used in greater or less quantity, and evidently with a most unsatisfactory result. It is plain that we at present possess no specific treatment against this poison, and the treatment will probably for a long time continue to be directed to merely relieving the symptoms; and that bleeding, opiates, and stimulants, with attention to the bowels, will long divide practitioners as to their respective merits. In the last stages of the affection, however, all perhaps will agree in the necessity of supporting the patient with wine, quina, &c.

With respect to local treatment, it may be laid down as a general principle, that, severe disease once established, a termination of the inflammation by resolution is out of the question, and that the best chance of recovering the patient is to adopt such measures as may lead to a healthy suppuration. Most authorities are agreed that leeches to the affected limb afford relief, and that their application is to be recommended, though not to such an extent as greatly to lower the patient; and in addition to leeches, that poultices should be applied to the inflamed part. Sometimes the pressure of the poultices is intolerable, and in these cases a local steam bath occasionally affords much relief. In addition to these warm applications, Dr. Lendrick recommends oil of turpentine and tinct. opii; while Dr. Osborn recommends pledgets, sprinkled with tinct. cantharidis, to be applied to the parts, and covered with the poultices. In some cases warm applications, instead of bringing relief, increase the sufferings of the patient, and then evaporating, or other cold lotions around the limb, should be substituted. When pus has formed, the propriety of making an opening is obvious.

It not unfrequently happens, however, that without any sufficient evidence existing of pus having formed, the patient is suffering most distressing pain from the great tension of the part affected, and this accompanied by a fluttering pulse, delirium, and great prostration. Under such circumstances, ought the swelling to be incised? Dr. Lendrick is of opinion, "If there be proof that the patient's sufferings are attributable to the parts being girt down by a tense fascia, there can be no doubt of the propriety of affording relief by an incision. But in the majority of cases," he adds, "the excessive pain is not referable to such a cause, and speculative incisions only increase the patient's torture; for I have been informed by patients that their sufferings, both general and local, have been increased by it."

Dietetic and Preventative Treatment.—In the early stages the diet of the patient should be slops and the usual antiphlogistic diet adopted in fever. In the latter

stages, and after pus is formed, wine, porter, and animal food are essential to the recovery of the patient.

As a preventative remedy, Dr. Macartney recommends the punctured part to be washed with a saturated solution of equal parts of alum and nitre. The most certain preventative, however, is the application of lunar caustic to the part immediately on the injury; but it should be remembered, the caustic will be of no avail after a few seconds, or a very few minutes.

Of the Poison of Porrigo.

Porrigo is a generic term for an eruption of psydracious pustules, usually termed *scald-head.* This disease is contagious, and has its especial seat in the scalp, but may extend over other parts of the body.

Remote Cause.—The origin of the poison, and the time of its first appearing, is entirely unknown.

Predisposing Causes.—The effects of *age* are very marked in the production of this disease, for porrigo is seldom seen except in childhood and in early adult age. The porrigo favosa and porrigo scutulata have been met with as early as the second or third day after birth, when the mother has been labouring under one or the other of those diseases; but the most common period is the seventh or eighth year. Every form of the disease is much less frequent after puberty, and, with some rare exceptions, is unknown in persons that are bald or advanced in life. Girls, from wearing their hair long, are supposed to be oftener affected than boys, and the feeble and scrofulous child is something more exposed to this affection than the strong and the healthy. The children of the rich, also, from their greater cleanliness and less exposure to the contagion, suffer much less from porrigo than those of the poor and indigent.

Contagious. — Bateman, Rayer, Willan, Mahon, Biet, and almost all writers agree, that certain forms of porrigo are contagious, although they differ as to the number of species possessing that property. Porrigo, however, is not eminently contagious, for although it often runs through schools, and is often traced from individual to individual, yet much difficulty has been found in communicating the disease by direct voluntary inoculation.

Fomites.—Bateman says, "This disease is principally propagated by contagion; that it is by the actual conveyance of the matter from the diseased to the healthy by the frequent contact of the heads of children, but more generally by the use of the same combs, caps, and hats;" "the multiplication of boarding-schools appearing to give increased prevalence to this disease," and the same testimony is given by Rayer, Willan, and most other writers, to the extension of this disease by similar fomites.

Pathology.—The theory of this disease is, that the poison is absorbed and infects the blood, and after a given period of latency produces a pustular eruption of a given character on the part of the scalp to which it has been applied, and subsequently perhaps of the whole scalp. A similar eruption sometimes appears on other parts of the body. The proof of the blood being infected in this disease is, that there have been cases in which the head has been shaved and carefully watched for many months, and each favus destroyed by lunar caustic as soon as it has appeared, yet the whole scalp has ultimately been covered with them, and, as far as could be judged, without any direct application of the poison.

Pathologists are not agreed as to the number of species of porrigo. Sauvages enumerates nine species; Willan six species; and Rayer only two species. It will perhaps be nearer the truth to limit them to four, or to the porrigo favosa, the porrigo lupinosa, the porrigo furfurans, and the porrigo scutulata. These species are distinguished by the different magnitudes of the pustules, the larger being termed favi, the smaller ones achores; also by some difference in the forms of their crusts or scabs. The frequency with which these different forms occur is not determined, but Alibert says, of the cases he treated in the Hôpital St. Louis, 90 per cent. were porrigo favosa.

The porrigo favosa, or *honey-combed* scald-head, is an eruption of the larger pustules or favi. The more recent writers have described four stages of the complaint, or a stage of vari, of pustule, of incrustation, and of ulceration.

The disease commences with a slight pruritus or itching of a few hours' duration, followed by an eruption of small red vari, sensible to the touch and to the sight. These augment in size, and before 12 hours have passed, a yellowish point forms on each of their apices, at first so small as to be only visible under a glass of considerable power, but which gradually increases, so that at the end of 24 hours it is as big as a millet seed, and this keeps gradually enlarging, till at the end of five or six days, it is of the size of a lentil. In some cases, however, they are 15 to 20 days attaining this magnitude. This pustule never acquires much elevation above the surface of the skin, and its form, according to some authors, is well-defined and regular, while others state it to be irregular and slightly umbilicated, or depressed in the centre. The peculiar matter which fills the pustule scarcely remains fluid for 12 hours after its formation, but concretes into a dry, brittle, candied, honeycombed looking scab or crust, which retains the form of the pustule, is similarly cupped or depressed in the centre, covered by the epidermis, while its under surface is marked by a small mammary process, which corresponds to the depression of the pustule. The honeycombed appearance of the scab gives the peculiar character of the disease, and hence the term "favus." The crust continues to increase, still preserving its circular form and depressed centre, till it occasionally attains a magnitude of five to six lines in diameter. When the crust is recent, it is of a yellow or fawn colour; as it becomes older its hue becomes lighter, and, as it is easily reduced to a powder, has been compared to pulverized sulphur.

The number of favi is considerable, and they commonly appear in crops, affecting the same or different parts of the head at distant intervals. They may be either distinct or confluent. When very numerous they are confluent, but the cupped form of the individual crusts may still frequently be recognized; and, according to Rayer, should this peculiar form be lost through the copiousness of the secretion, still, by removing the superficial layers, each particular favus, with its central depression, may in general be made out. At a more advanced stage of the disease the epidermis disappears, and a viscid fluid is secreted in such abundance as to form one entire incrustation over the whole head; hence porrigo larvalis, or mask or vizor-like scald-head. The smell of the scab is peculiar, and has been compared to that of the urine of a cat, or of a cage in which mice have been kept.

When a crust of recent formation is removed, a cir-

cular depression, wider and deeper than the favus, is seen. At a more advanced stage the ulceration penetrates below the dermoid tissue. Indeed Alibert says, he has never been able to remove a crust for the purpose of making a preparation without deeply wounding the scalp, and producing considerable hæmorrhage, while in some cases a deep and extensive ulceration takes place, which has penetrated even to the bones of the cranium.

In this form of the disease the hair of the part is most commonly diseased and stands awry, and, if extracted, is found looser than natural. According to Dr. Willis, the root in the first stage is covered with a layer of white matter like coagulated albumen, and a day or two after a puriform fluid surrounds the shaft. In some cases the hair-bulb is partially destroyed, and baldness of those parts ensues; but in general, when the disease terminates, the hair, though weak at first, is entirely restored, and its colour unimpaired.

In most persons the favi occupy only the scalp; but in a few instances they form on the forehead, temples, shoulder, or fore arm. Alibert has seen them on the loins, the sacrum, the knees, and on the upper third of the leg; and Bateman has seen them on the feet and toes. It is singular, however, says Mahon, they are never found on the pubes or axillæ, a fact strongly militating against the hypothesis of the hair-bulb being the seat of the disorder. The most remarkable fact, however, is, that the nails, both of the toes and feet, have been known to be affected, being elongated and thickened; the regularity and polish of their surface giving place to longitudinal rugosities, and ultimately dividing into branches at their extremities, resembling, as has been fancifully observed, the statue of Daphne changing into a laurel. The diseased nails are not shed, but acquire an unusual sensibility; their colour is yellow, like the favus, and when cut they discharge a similar viscid fluid. This disease is said never to be cured, the nail preserving the modification which disease has imposed on it.

When porrigo forms on other parts than the head, the anatomical structure of the cutis being different, there is a remarkable difference in the severity of the disease; for the scab is very superficial, and the skin appears rather abraded than ulcerated, while the inflammation is rather diffuse than pustular.

The *Porrigo lupinosa* is an accidental variety, in which the scab resembles a lupine rather than the cell of the honeycomb, and is very rarely seen.

The *Porrigo scutulata*, so named from a shield-like appearance of the scab, like the porrigo favosa, has four stages; the first being such inflammation as causes the hair to fall off; the second is the formation of the pustule; the third is the process of incrustation; and the last is that of ulceration. The disease, however, may terminate in the first or any succeeding stage, without running through the whole number. In the first stage, the hair falls off, and the patch thus made is very generally circular or oval, its margin well-defined, and covered with scurf. When of some extent and well marked, the patch is soft, doughy, and painful when pressed upon. Some of the hair appears to be removed by the roots, while other portions are broken off near the scalp, the roots remaining. Those which remain are readily removed by friction, and if pulled have scarcely any hold of the scalp.

After an uncertain time the second stage commences by an eruption of the smaller pustules or achores. These are small yellow points, not prominent, generally traversed by a hair, much more numerous at the circumference than at the centre of the patch, and are soon succeeded by scabs, imagined to have some resemblance to a shield, which unite in such a manner as to form incrustations of the breadth of the eruption. If the pustules be left to themselves, not only do the areas of the primary clusters extend, but their edges blend together, forming extensive and irregular patches. If the progress of the disease be unimpeded, the patches may so extend, that at length there remains only a narrow border of the hair uninjured round the head. When the scabs are removed, the surface of the patch is red and shining, studded with slightly elevated points or papulæ, in some of which minute globules of pus may occasionally be seen. In some few cases extensive ulceration of the scalp takes place.

The *Porrigo furfurans*, or scurf-like scald head, is the last form of this disease, and commences with an eruption of small achores. The discharge from the pustules is trifling in quantity, and the excoriation slight. The humour, therefore, soon concretes and separates into thin lamellated scabs or scurf-like exfoliations. At irregular periods the pustules re-appear and discharge, but soon dry up and exfoliate. This form is attended with a good deal of itching and some soreness of the scalp, to which the disease is confined; the hair also either falls off, or else becomes thin, less strong in its texture, and lighter in colour. Occasionally the glands of the neck are swollen and painful.

Symptoms.—The symptoms are entirely local, the constitution being seldom in any degree affected.

Diagnosis.—A practised eye will readily distinguish these diseases from lepra, or other eruptions to which the scalp is liable.

Treatment.—The treatment of the forms of porrigo is not very strictly determined. Thus, in attempting the cure of porrigo favosa, some practitioners rely entirely on a constitutional treatment, as on small doses of rhubarb and soda, small doses of mercury, some preparation of iron, or else on vegetable tonics, as the inf. cascarillæ or compound infusion of gentian. Others, again, as entirely rely on a local treatment, attempting to exterminate the disease by cauterization, or else by applying some favourite ointment; and the catalogue of ointments used for this purpose includes all that have at any time been admitted into the pharmacopœia.

The best method, however, of treating porrigo favosa is to shave the head, and apply a poultice till all the scabs, or nearly so, are removed, and this being effected, the whole scalp should be anointed with the tar ointment (unguentum picis liquidæ). This ointment should be washed off night and morning with soft soap and water, and be as often re-applied. The head also should be shaved twice or thrice a week, and where there are other children, the affected child should wear an oil-skin cap to prevent the disease from spreading. This form of porrigo in the early stages will sometimes yield by washing the part with the oleum terebinthinæ night and morning, and cutting the hair close.

The *porrigo scutulata* is a disease often rebellious to every mode of treatment, but applied at a favourable moment every method succeeds. Dr. Willis has seen the disease yield to fomentations, or to bread poultices; while applying the lunar caustic round the patches about a line from their outer margin, is another favourite method. In the latter periods of the disease, Dr. Willis

recommends "a solution of sulphate of copper, gr. vij. to x. to the ounce of water; of the nitrate of silver in the same proportions: the mild ointment of the nitrate of mercury, a salve of the black sulphuret of the same metal (sulphuretum hydrargyri nigr. ʒ j. ad ʒ ij. adipis ℥ j.); the unguentum picis, an unguent of the cocculus Indicus pulveriz. ʒ j. to ʒ ij. adipis ℥ j., may be tried one after the other; and in different instances each will have the merit of the cure." "The most effectual remedy in itself is unquestionably the eradication of the affected hairs. These are to be removed singly with the forceps, not pulled out along with all the healthy growth in their neighbourhood, as used formerly to be done by the barbarous application of the pitch-cap."

This disease occurring on surfaces not particularly covered with hair yields at once to the application of a solution of sulphate of copper, or of the nitrate of silver in water.

Of the Paludal Poison.

The marsh generates a poison which produces intermittent, remittent, and yellow fevers, and also dysentery. It will be more convenient, however, to treat first of the paludal fevers, and then of dysentery. This class of disease, so interesting to the medical philosopher, and formerly so destructive, has almost disappeared from this country, owing to the improved drainage both of the towns and of the agricultural districts, for only 95 cases are reported to have died of ague in England and Wales in 1839.

Remote Cause. — The facts collected by medical writers from Hippocrates downwards, show that every country is unhealthy in proportion to the quantity of marsh, or of undrained alluvial soil that it contains; the inhabitants of such districts dying often in the ratio of 1 in 20, instead of 1 in 38, the average mortality in healthy countries, and also that the diseases from which death results in these districts are peculiar fevers of an intermittent or remittent type, varying in severity according to the temperature or latitude of the place, and also dysentery. The connexion of a given class of disease with marshy districts is thus distinctly established, and the inference of necessity drawn is, that it depends on a peculiar cause, or a paludal poison generated by the marsh, and we have an endless series of instances to establish the truth of this deduction.

Ancient Rome was once the seat of so many fatal epidemics, that the Romans erected a temple to the goddess Febris. These arose from the great masses of water poured down from the Palatine, Aventine, and Tarpæian hills becoming stagnant in the plains below, and converting them into swamps and marshes. The elder Tarquin ordered them to be drained, and led their waters by means of sewers to the Tiber. These subterraneous conduits ramified in every direction under the city, and were of such considerable height and breadth, that Pliny terms them "operum omnium dictu maximum suffossis montibus atque urbe pensili subterque navigata;" and this system of drainage, which was continued as late as the Cæsars, rendered Rome proportionably healthy, and the seat of a larger population than has since perhaps been collected within the walls of any city. On the invasion of the Goths, however, the public buildings were destroyed, the embankments of the Tiber broken down, the aqueducts laid in ruins, the sewers obstructed and filled up, and the whole country being now again overflowed, Rome once more became the seat of an almost annual paludal fever, as in the times of her earliest foundation.

The insalubrity of the Pontine marshes, past or present, is notorious. Three hundred years, however, before the Christian æra, Appius Claudius drained them by making canals, building bridges, and by constructing that magnificent road, portions of which still remain, and still bear his name. This road, the "regina viarum," was the especial care of the Gracchi, of Julius Cæsar, of Augustus, of Trajan, of Vespasian, and of the Roman Emperors generally; and was that on which Horace delighted to travel on account of the number and excellence of its inns, for "minus est gravis Appia tardis." On the invasion, however, of Italy by Theodoric, Cæcilius Decius gave a free course to the waters in the neighbourhood of Rome, and the re-establishment of these immense marshes was one of the many disasters which resulted from the attacks of the Goths on Italy. Their present state is such, that the Tuscan portion of the Maremme, and indeed the whole of that district, may be said in summer to be absolutely depopulated, not a single house retaining an inhabitant, except the guard-houses, with a few soldiers and custom-house officers, and these are relieved twice or thrice during the summer with the Maremme fever almost invariably upon them.

Of modern towns that have been drained and remained healthy there are many examples. London, for example, in the time of Sydenham, was infested with epidemic intermittent fever and dysentery, the mortality from the former alone averaging, in a comparatively small population, from one to two thousand persons annually. In the present day, owing to the formation of sewers and a general system of drainage, a case of ague contracted in London is hardly known. Many other towns, both of this country and of France, as Portsmouth, Rochefort, and Bordeaux, from being the constant seat of paludal fevers, have been from the same causes rendered in like manner perfectly healthy.

The intimate connexion, therefore, between marshy districts and certain diseases is thus established by a great amount of direct or indirect evidence; the next proposition is, what is the nature of the noxious agent, and what circumstances are necessary to its formation or extrication?

It seems certain that the deleterious agent is neither heat nor moisture, nor any gas extricated from the marsh. It cannot be heat, for many of the hottest parts of the West Indies, as the sandy quais, are free from fever. It cannot be moisture, for no persons enjoy better health than the crews of a clean ship at sea, even when cruizing in tropical climates, as long as they have no communication with the land. While carbonic acid, azote, oxygen, or carburetted hydrogen, the gases collected by stirring the bottom of marshes, have all been inspired without producing any disease similar to paludal fever, and it seems consequently to follow almost as a necessary consequence, that the remote cause must be a miasm, poison, or malaria, whose presence is solely detected by its action on the human body, and two hypotheses have been imagined to account for its origin; the one, that it is a product of vegetable decomposition; the other, that it is an exhalation from the earth, favoured by the conditions of the marsh.

The general evidence in favour of vegetable decomposition being the remote cause is, that all countries are for the most part free from paludal diseases while the

crops are growing, and only become unhealthy after the harvest, when large quantities of vegetable matters are left on the ground at the time the rain begins to fall. It may be said that, except rice, we neither reap nor sow in marshes. This is unquestionably true; but it will be seen hereafter that marshes are in general healthy till the summer's sun, or other cause, has diminished their waters, and bared a greater or less portion of their bed. The part thus exposed almost always contains a large portion of vegetable matters, which, running into rapid decomposition, generate the poison which gives origin to this class of disease.

The particular evidence of vegetable decomposition being the source of this poison is as follows:—Lancisi, for example, gives the history of an epidemic remittent, or intermittent, which for several summers infested, and almost depopulated, the ancient town of Urbs Vetus, situated on an elevated and salubrious part of Etruria, and which was traced to the circumstance of the peasants steeping their flax in some stagnant water in the neighbourhood of the town. This practice was therefore prohibited in 1705, and the epidemic ceased to appear. The apprehension of the steeping of flax being productive of paludal fever is not limited to Italy, for the ancient as well as the new "coutumes" of almost all the provinces of France have proscribed the steeping of flax, "la rouissage," even in running waters, from the fear of infection, and this prohibition forms part of the "droit public" of that kingdom. In the Netherlands also the same belief prevails, or has prevailed; for, in July, 1627, the King of Spain passed an ordinance, prohibiting the steeping of flax in the streams and canals of Flanders.

The experience of the indigo-planter is to the same effect. In India, after the colouring matter has been extracted from the indigo plant, it was formerly the custom to throw the detritus into large heaps or masses in the immediate neighbourhood of the works, and which, at the end of three or four years, becomes manure of an excellent quality. It was found, however, that these heaps, wetted from time to time by the heavy rains, and afterwards heated by the rays of a burning sun, rapidly decomposed, and at length emitted miasmata, which produced all the effects of those extricated from the marsh; for the workmen who lived near, and more especially those to leeward of these masses, were found to be very commonly attacked by fever, chiefly of the remittent type, and similar to those which prevail in the paludal districts of that country. This consequence is now so well established that the most intelligent indigo-planters no longer allow these heaps to be formed either near the works or in the immediate neighbourhood of the cottages of their workmen.

Ships also afford additional evidence of the truth of the hypothesis of vegetable decomposition being the remote cause. The Priamus frigate underwent some repairs at Plymouth previous to a voyage to the West Indies, but the chips and shavings, instead of being removed, were allowed to remain and to mix with the bilge-water under the limber-boards. On the voyage the foul state of the hold was indicated by the most offensive smells, and at Antigua a fever broke out, which daily destroyed increasing numbers. The true cause was not yet suspected, and a voyage was undertaken with a view of mitigating the calamity, but without success. The ship at length returned to Antigua, and the state of the hold was examined, and of the effect produced by this proceeding Mr. Hartle, one of the medical officers present, gives the following account:—When the limber-boards were removed the effluvium surpassed everything he had before experienced; a boatswain looking into the hold, fainted, and afterwards passed through a formidable attack of fever. Every individual also present likewise suffered from fever, and Mr. Hartle himself suffered from a slight indisposition. Although the frigate had only been six months from England, four large mud-boats of filth were removed from her, and which lay nine inches thick in the hold. Even the negroes employed in removing this mass were obliged to go on deck occasionally, so insufferable was the stench, and three of them had the characteristic disease. The after magazine, immediately under the gun-room, was found in the worst state, and this accounted, in the opinion of Mr. Hartle, for every officer's servant and every servant of the gun-room mess having suffered. Several cases occurred after the removal of the crew, in consequence, as it was discovered, of the men having gone on board clandestinely. The ship having been cleansed and thoroughly purified, the general health of the crew was restored, and on their returning on board continued good.

These facts render it highly probable that the noxious agent must be a product of vegetable decomposition, changed from a fixed to an aëriform state, and evolved in the lower regions of the atmosphere. But it must be admitted no eudiometry has yet been able to discover the immediate principle. The atmospheric air collected at the embouchure of the Valtelline, a country where it is impossible to sleep without being attacked with fever, gives, on analysis, the same constituent parts and proportions of gases as that collected at the summit of the Alps, or in the narrowest streets in London. Moscati has condensed the exhalations of the marsh as they arose, by means of glass globes filled with ice, but these experiments have not led to any discovery, nor have they in the least degree elucidated the subject.

If we consider the paludal poison to be a product of vegetable decomposition, it follows that heat and moisture, quantity of vegetable matter and nature of the soil, though not the essential agent, must have a sensible influence on its formation, must vary its intensity or quantity, and also must limit paludal diseases to particular localities, seasons, and latitudes. A certain temperature, for example, is evidently necessary to its extrication; for should the heat be excessive, the vegetable substance, rapidly parting with its juices, is dried up or charred even before decomposition commences. Thus, in all tropical countries, even the most pestilential, the hot season is the season of health, and during the dry period of the year most parts of the country are as pleasant and healthy as any part of the world. But no sooner do the rains fall and the parched crust of the earth become softened, than vegetable decomposition commences, and so actively that the ground emits a most offensive stench, and a general and violent sickness follows. On the other hand, in countries of a low temperature, as towards the polar regions, the decomposition of vegetable matter is so slow that even the marsh is healthy.

It is certain also that a given quantity of moisture is as necessary to vegetable decomposition as a given temperature, and that the extrication of the paludal poison will be most abundant from that soil which contains no

Elementary Principles of Medicine.

more moisture than is necessary for that process; for an excess in quantity, by dividing and separating the particles, and by preventing the access of atmospheric air, will either retard or altogether put a stop to putrescency. This law is most important, as it explains the reason why in some countries frequent and heavy rains will render marsh fevers prevalent, by saturating the whole of the open country, while privation of rain will in others produce exactly the same effect in other instances, merely by diminishing the superfluous quantity of water. Thus in the West Indies an uncommonly rainy season seldom fails, in the perfectly dry and well-cleared island of Barbadoes, to induce for a time general sickness; while at Trinidad, whose central portions are described as a sea of swamp, and where it rains nine months in the year, an excess of moisture is a preservation from sickness; for should at any time rains fall only eight months in the year instead of nine, the swamps become dry and bared to the sun, and remittent fevers of the worst kind are sure to make their appearance; and the same result follows on the subsiding of the waters of rivers that have overflowed their banks, as those of the Nile, the Rhone, the Danube, the Tigris, or the Ganges.

It is evident from these data that the swamp, on its approach to dryness, is the harbinger of disease and death, while an excess of rain is a preservative power. On the contrary, on the rich and dry plains, and even on the hills of tropical countries, rain is the cause not only of vegetable decomposition but also of disease, while dryness is the preservation of health.

In estimating, however, the dryness of a country, its superficial appearance is often deceitful. In the years 1748 and 1794 the summers were dry, and our troops took up the encampments of Rosendral and Ousterhout in South Holland. The soil in both places is a level plain of sand with a perfectly dry surface, and where no other vegetation existed or could exist but a few stunted heath-plants; yet in both years fever became epidemic among the troops in each place. On digging for water the cause was discovered, for the soil was found to be percolated with water to within a few inches of the surface. It is probable, therefore, that this country was originally formed of vegetable and other detritus, brought down by the Rhine and the Waal, and afterwards covered with sand thrown up by the sea, and which, heated by the summer's sun, became the powerful cause of the extrication of marsh miasmata. From the exceeding malignity of the salt marshes, it has been supposed that a mixture of salt and fresh water rendered a marsh more pernicious than either of them alone, on account of its destroying certain animals and vegetables that can exist only in the one or the other medium. It has been found, however, that on coasts where these marshes have been kept up to one uniform level by means of flood-gates, that the surrounding country is healthy; it has therefore been inferred that the sickness produced was a consequence of the perpetual alteration of the level of the waters of the marsh, and not owing to the admixture of sea and spring water. It is probably owing to a great excess of temperature that rocky countries, as Gibraltar and the Ionian Islands, are so often and so severely attacked with fever.

It is on the summits of these rocks that springs arise. The slightest frost produces fissures, into which mould and vegetable matters insinuate themselves, while the bare rock becomes heated to an intense degree. Humboldt, on ascending the Orinoco, found the station at the great fall depopulated by fever, which the natives attributed to the bare rocks of the rapids. He determined the heat of these rocks to be 118·4°, while the thermometer of the air immediately around was only 78·8°. Again, the rock of Gibraltar is known to be percolated with water, so that we can hardly conceive a more pestilential focus of disease, when the chemical causes necessary to the formation of miasm are combined. The existence of paludal fever in dry and rocky districts, therefore, although it may appear extraordinary and unexpected, is not necessarily an exception to the general law of paludal diseases being generated by miasmata generated by vegetable decomposition.

These facts seem, therefore, unquestionably to prove that heat and moisture, though not the primary cause of paludal disease, are conditions essentially connected with the extrication of the noxious miasmata, and consequently are a strong additional argument in favour of the hypothesis of vegetable decomposition generating the remote cause which produces them. It is certain, however, even when the conditions of heat, moisture, and vegetable matter most abound, that the paludal diseases do not always assume their severest forms: thus Jamaica is more unhealthy than Demerara, Demerara than Barbadoes; and, taking the West Indies generally, that country is more unhealthy than that of the East Indies. There must be other circumstances, therefore, affecting the problem in question; and there seems reason to believe that differences of geological formation, by favouring or otherwise influencing vegetable putrefaction, may greatly affect the health of countries similarly situated.

It is perfectly well known that different soils radiate heat with very different degrees of intensity, and consequently are, under the same circumstances, of very different temperatures, have very different powers of attracting moisture, and possibly also they may have other and more direct chemical affinities for generating or attracting the paludal miasm. Nothing, for instance, is better determined in husbandry than that the carbonate of lime, mixed with the ordinary matters of a compost, greatly forwards the processes of putrefaction, so that the mass thus prepared is fit in a much shorter time for the purposes of manure. The causes which occasion this rapid decomposition have been investigated by Sir Humphrey Davy, and he has ascertained that lands situated in calcareous districts, like the West Indies, where the surface is a species of marl a few inches deep, lying above limestone earth, are extremely hot, and attract moisture largely. No springs, it is well known, arise on chalky hills, the water being unable to penetrate so impervious a soil; yet it is of common observation that the ponds on those hills are always full. The different powers of absorption of water by different soils is often beautifully seen in this country; for the sandstone and limestone hills of Derbyshire and of North Wales, for example, may be easily distinguished from each other at a considerable distance by their different tints of verdure; the grass on the sand-stone hills being usually brown and burnt up, while that on the lime-stone is flourishing and green. Now if the difference in the absorbing powers of different soils in this country is so striking when the atmosphere contains only 1-75th part of its weight of vapour, how much greater results must arise from this difference of soil between the tropics, where the atmosphere con-

tains three times that quantity, or 1-21st part of its own weight of vapour. It appears, therefore, there are some soils peculiarly favourable to the decomposition of vegetable matters, and consequently to the more abundant extrication of marsh miasmata; and it is remarkable that those countries most celebrated for paludal fevers have been found similar in their geological formation to each other, and to those artificial conditions which most favour rapid vegetable decomposition.

It seems probable also that the volcanic matters which enter so largely into the structure of the West India islands add to the intensity of the miasm, and thus cause the severest forms of paludal disease. It is perhaps to this cause that the severe paludal fevers which occasionally appear in the rocky and volcanic countries of Europe, as Gibraltar, the Campagna di Roma, many parts of Spain, and the Ionian Islands, are partly owing.

Of the matters evolved in volcanic eruptions, it seems probable that sulphur is the agent which, by its affinity, adds to the intensity of the miasm, for that substance appears to exist in a remarkable degree on the western coast of Africa, a spot fatal beyond all others to European settlers. An experience of between 30 and 40 years, for example, has shown that the copper sheathing of a ship will be as much or more injured in a nine months' cruize off that coast as from a similar service of three or four years in any other quarter. This circumstance induced the Lords of the Admiralty to send to Mr. Daniel, for analysis, a quantity of sea water drawn between the 15° and 16° of latitude of that coast; and that celebrated chemist has shown that it contains a considerable quantity of sulphuretted hydrogen, arising either from a soil having a volcanic origin, or else from the decomposition of the sulphates contained in sea water by the carbonaceous matters arising from the decomposition of the immense quantities of vegetable matters, which grow down even to the water's edge in that country. If sulphuretted hydrogen should hereafter be determined to be an element increasing the virulence of the disease, it will be an interesting question whether it acts merely as a depressant, or whether, by combining with the poison, it augments its intensity.

It is highly improbable we shall ever arrive at such an exact knowledge of the causes which affect the extrication of marsh miasmata as to enable us to predicate all the facts connected with paludal diseases; for the variations of atmospheric temperature, the changes in the quantity and nature of the electric fluid, the quantity of water, the nature of the soil, the amount and character of the vegetable matters, form a problem extremely complicated, and one whose smallest variation as to quantity or time may occasion marked differences in the result. As a general rule, however, it may be stated, that in no climate do paludal fevers prevail to an equal degree all the year round. In the winter much of the vegetable matter has already undergone decomposition, while the dryness of the season, and the diminished temperature, are little favourable to further putrefaction. When the spring, however, arrives, and the rain falls, and the heat of the sun increases, the earth again opens its bosom, and a miasm of mitigated intensity is again developed. In summer the products of vegetable decomposition are used up in affording nourishment to the growing crops, and this season, like the winter, is in general healthy. But in the autumn, and after the harvest has been gathered, when the ground is covered with vegetable debris, when the rain falls in torrents, and when the solar heat has acquired its greatest intensity, all the conditions of the greatest quantity of vegetable matter, of moisture, and of highest temperature are united; so that the season which realizes the hopes of the husbandman is also the period of pestilence and of his greatest danger. There are two other facts also which are too prominent to be mistaken: the one is, that the miasmata vary greatly in intensity in different countries, and also in different parts of the same country. Again, the diseases they produce, though annually *endemic* in given districts, yet become in certain years, and from the action of causes not yet determined, *epidemic*.

The proof that the miasmata vary greatly in intensity is, that paludal fevers vary in severity in different countries, and even in the same country, under different circumstances, assuming the different forms of intermittent, remittent, and yellow fever. In this country, when the summer is short and but moderately hot, the type of the marsh fevers is not usually of a dangerous character, and they are for the most part mild intermittents, only occasionally assuming a remittent form. In Holland and the Netherlands, and in the north of Germany, the intermittents are of a bad kind, and not unfrequently become remittent. In the still hotter climates of Spain and Italy, as well as in the more tropical regions, the intermittent is less common, while the remittent is frequent, violent, and not unusually assumes the form of yellow fever.

In the same countries also it is determined that difference of altitude is equivalent to difference of latitude; and, as a general law, it may be stated that in the Antilles, on the continent of America from Boston to Rio Janeiro, and also on the continents of Asia and Africa, that while in the low country severe remittent or yellow fever prevails, still in the higher country, though immediately contiguous, the type is changed to intermittents and mild remittents. The interesting fact stated by Humboldt, that the vomito prieto never appears on the table lands of Mexico, is strictly in accordance with the observations made in every other equatorial part of the world at a similar elevation above the level of the sea.

The symptoms of intermittent, remittent, and yellow fever differing in many respects from each other, it may be doubted whether these diseases arise from the same cause, differing only in intensity. The circumstance, however, of intermittents passing into remittents, and remittents into yellow fever, and conversely of remitting and yellow fever often terminating in intermittent—facts observed not only in the East and West Indies, but on the continents of America and of Africa—demonstrate an unity of cause as firmly as the best established facts in medicine.

The law that paludal diseases, like many diseases produced by morbid poisons, are annually endemic, and only occasionally epidemic, is unquestionable. A few years ago intermittent fever was epidemic in particular districts in this country, but of late years the cases of ague have been comparatively rare. In Demerara it is observed that yellow fever is epidemic about every seventh year. At Gibraltar, although sporadic cases of paludal fever occur annually, still yellow fever is only occasionally epidemic, but so irregularly, that it assumed that character in 1804, then in 1810, again in 1813 and in 1814, and from that period the garrison suffered no

similar visitation till 1828. The physical causes on which this greater virulence and greater spread of the disease depends are not determined. In temperate climates it has been observed that paludal fevers have been most epidemic when a hot summer has succeeded a wet spring. In the West Indies, however, they often appear without any warning, and without any sensible change in the quantity of rain, or in the height either of the barometer or thermometer. They follow no given cause, but, like influenza or cholera, appear to be altogether the result of inscrutable influences.

Having thus stated the general laws which relate to the extrication of marsh miasmata, it is now necessary to ascertain those limits within which the poison issuing from its source may infect the human body.

Infecting Distance.—As a general law the danger of infection is in proportion to the proximity of the party to the marsh; but there are many disturbing causes, which produce many remarkable exceptions to this law, and render the solution of the problem one of extreme difficulty, as the extent of surface which generates the miasmata, their intensity, the direction of the wind, its force, the season of the year, the time of the day, and the attracting influence of the surface over which they pass. These data are so multifarious that it is impossible to do more than assign the most general facts, both as to the altitudinal as well as to the lateral range.

The altitudinal Range.—The Monte Mario, which adjoins Rome, is, according to Breyslack, about 165 yards' perpendicular height, above the Pontine Marshes, and is extremely unhealthy. Tivoli, which is about 230 yards above the level of the same marshes, is infinitely more salubrious; while at Serre, 340 yards' perpendicular height, the inhabitants enjoy an entire exemption from the paludal diseases which prevail below. In Italy it is estimated that an altitude of 1400 to 1600 feet is necessary to assure an exemption from paludal disease; but in the West Indies, where the poison is of so much greater intensity than in Italy, it is estimated that an elevation of 2000 to 2500 feet is necessary to give a similar immunity.

In towns partially freed from marsh miasmata by extensive drainage, the difference of a few feet perpendicular height makes an almost inconceivable difference in the liability of persons to paludal disease. The barracks of Spanish Town, the capital of Jamaica, for instance, consist of two stories, or of a ground floor and of a first floor; but it being found that two men were taken ill on the ground-floor for one on the first-floor, it was at length ordered that the ground floor should be no longer occupied. Dr. Cullen remarked a similar result at Portobello, Dr. Ferguson in St. Domingo, and Sir Gilbert Blane in the expedition to Walcheren. This law is so well understood in the West Indies, that in Demerara, and in many other parts, the houses are built on dwarf columns, after the manner of our corn stacks, in order that a stratum of air may be interposed between the house and the ground. In Rome, and in other towns of Italy, it is also so well known that the lower rooms of the houses are abandoned to the servants, the family occupying the upper rooms, as affording a greater protection from the paludal poison.

The *Lateral or Horizontal spread* of marsh miasmata is a problem still more difficult than that of the altitudinal range. The least complicated cases are those when water alone intervenes between the marsh and the recipient. In the year 1746–7, while our troops lay in Zealand, the sickness was so great among four battalions quartered there, that some of those corps had hardly 100 men fit for duty, or less than a seventh part of a battalion. In one corps, the Royals, only four men escaped. At the time, however, of this remarkable prevalence of fever on shore, Commodore Mitchell's squadron lay at anchor between South Beveland and the island of Walcheren, and the fever raged at both places; but nevertheless, in the midst of all the sickness that reigned around, the seamen were neither affected with fever nor flux, but continued to enjoy perfect health. These observations of Sir John Pringle were fully confirmed by those of Sir Gilbert Blane, during the last disastrous expedition to Walcheren: "I had," says this physician, "the opportunity of observing the extent to which this noxious exhalation extended, which was found to be less than was generally known. Not only the crews of the ships in the road of Flushing were entirely free from this epidemic, but also the guard-ship, which was stationed in the narrow channel between this island and Beveland. The width of this channel is about 6000 feet: yet, though some of the ships lay nearer to one shore than to the other, there was no instance of any of the men or officers being taken ill with the same disorder as that with which the troops on shore were affected." It appears, therefore, that in Europe the horizontal spread of marsh miasmata over fresh water is less than 3000 feet. With respect to the spread of the miasmata over salt water, Sir Gilbert Blane is also of opinion, that in tropical climates ships at a distance of 3000 feet from a swampy shore—a distance to which the miasmata did not extend in Zealand—and even further, were affected with the noxious exhalations. Dr. John Hunter considers a few miles to be a necessary interval for a ship lying to leeward of a swamp, in order to ensure a complete exemption from the disease. When, however, the swamp or other source of the poison is of small extent, a much less space is sufficient to assure an exemption. In the epidemic on the coast of Spain, the fisherman living with his family on board his boat has been rarely attacked, though lying at anchor close in shore. Also, during the late epidemics at Gibraltar, it was not unusual for the richer inhabitants to hire a Moorish vessel, and to live on board in the bay; and there was scarcely an instance of those persons having been affected, though keeping up a free communication during the day, either directly or indirectly, with the town. The explanation of the exemption of ships riding in rivers or shallow waters is, that the water in these situations is often much hotter than the land, or the atmospheric air, and consequently the vapour the latter contains is not condensed or deposited. In harbour, also, if the water be shallow, the same thing must take place; while in deeper water the temperature of the water is sometimes lower than that of the land, and consequently the poison is often precipitated, and at considerable distances from the swamp.

The extent to which marsh miasmata may spread from its source over land, in a horizontal direction, is a much more complicated question, on account of the different affinity which either the poison, or the vapour which it holds in solution, has for the many substances over which it passes; for different soils act as so many attracting or repelling causes, tending to limit or extend the spread of the poison. The effect of trees in intercepting the paludal poison is remarkable, and appears to have been known to the ancients, who are supposed to have surrounded their temples with groves

on account of their protecting influence. Pope Benedict XIV. ordered a wood to be cut down which separated Villatri from the Pontine Marshes, and, in consequence, for many following years there raged throughout the whole country, and in places never before attacked, a most severe and fatal fever. The same effects were produced from a similar circumstance in the environs of Campo Santo. On the contrary, even in the West Indies, it is quite wonderful how near the marsh the planter, provided he is protected by trees, will venture to place his habitation. It is probable the immunity arises from the trees partly condensing the vapour of the marsh, and partly, perhaps, by their giving an upward direction to the current.

Different soils also act as attracting or repelling causes which affect the transmission of the paludal poison. The spot, for instance, on which the new National Dock and arsenal are built was a marsh of about 700 acres, and on either side of it are the villages of Greenhithe and of Northfleet. The peculiarity in this case is, that the inhabitants of these villages rarely suffered from intermittent fever, whilst those on the hills beyond were greatly afflicted with that disease. Dr. Maton mentions a similar fact in the neighbourhood of Weymouth, and the same circumstance is observed also in the neighbourhood of Little Hampton, and the marshy districts in Sussex.

The different force by which the paludal poison is attracted by different surfaces has often been observed in the West Indies. Fort Hildane at Porto Maria, Jamaica, occupies the extreme point of a promontory which projects considerably from the main land, and divides the bay into two basin-like recesses. This promontory, which is 150 feet above the level of the sea, and 200 feet across, is so nearly perpendicular, and so nearly alike in all its faces, that it has the appearance of an artificial structure raised for the defence of the harbour. It is formed of pure carbonate of lime, and looking at it merely as a dry mass of chalk, washed on three sides by the sea, we should imagine it to be one of the healthiest situations in the West Indies; yet, strange to say, the inhabitants at its base, and living on the banks of a sluggish river, covered with mangrove, are healthy, while the troops quartered on the rock were so rapidly destroyed by fever that for some years past it has not been garrisoned. In attempting to assign the law which may explain these varying and often apparently opposite phenomena, there is no hypothesis so satisfactory as that which supposes the diffusion of the paludal poison to follow the same laws as those which govern the vapour or dew, by which it is held either in a state of solution or suspension, and which, it is well known, is variously attracted and repelled by various soils, and the vegetable productions which cover them.

Predisposing Causes.—The paludal poison spares no *age*; for the infant at the breast, the adult, and the decrepit with age, are alike seen to shake with ague, or to suffer from some severe form of the disease. The adult, however, from his greater exposure to the cause, suffers the most. It has been supposed that our liability to the action of this poison decreases with increasing years; but the veteran soldier is found to suffer in a two-fold degree over the recruit. It is well known that the life of a woman is twice as good as that of a man, in the West Indies; but when the wives of the common soldiers have been equally exposed with their husbands, they have suffered in an equal proportion.

It appears that *race* greatly affects the liability to this class of disease. The white troops in the West Indies suffer a mortality of 36·9 per 1000, while the black troops only lose at the rate of 4·6 per 1000 from the same cause. It is certain that in every country the natives suffer much less than strangers; the sepoys, for instance, suffer as one in four and a-half, Europeans as one in three. Our invasions of Holland, Spain, of the Birman and Chinese empires, have been most disastrous to the troops; not, however, from losses in battle, so much as from the devastations of paludal disease, while the natives of those countries have not suffered in any unusual degree. The expedition of the French to Africa has also been attended with a similarly great fatality.

The different ranks of life have also a different liability; thus, the soldier is twice as liable to paludal fever as his officer. In every country, also, the poor suffer more than the rich; and again, the largest proportionate loss has occurred in the most densely populated districts. It has been supposed that habits of rigid temperance are not greatly protective from this disease. When, however, intemperance leads to exposure to the night air, it is most pernicious; and our armies, when on actual service, have on all occasions been more than decimated in a very few days from these conjoined causes. The most healthy period of the day is from three to six in the afternoon, after the greatest heat of the day is past, and before the dew falls. The most unhealthy is from sun-set to sun-rise. The most unhealthy season of the year is when the greatest degree of heat is combined with the greatest degree of moisture, or, in the northern hemisphere, between July and October. It is then we should take care that the sickening damp, the cold autumnal fog, "hang not relaxing on the springs of life."

Susceptibility not exhausted.—It has been supposed that a long residence in a paludal country destroys all susceptibility to the action of the paludal poison; but the returns published by the War Office and Army Medical Department painfully show a contrary result in the West Indies. Thus, while the annual mortality among the troops resident one year in Jamaica was 77 per 1000, mean strength; in those resident two years it was 87 per 1000; while of those still longer resident, it was no less than 93 per 1000.

It has also been imagined by many writers that persons who have suffered from one attack of paludal fever have an immunity from a second attack; Sir James Mac Grigor, however, states, "That in making calculations of efficient force, this description of men could not be relied on for operations long continued in the field," for "we found that in those who were convalescent or lately recovered from ague, the causes next prone to re-produce the disease were exposure to a shower of rain, or wetting the feet, full exposure to the direct rays of the sun, or to cold, with intemperance, irregularity, or great fatigue." There are many instances, also, of the same party being repeatedly attacked with the West Indian fever.

Co-exists.—This law has not been sufficiently studied; but small-pox and intermittent fever, scabies and intermittent fever, have often been seen conjoined, and there can be no doubt of the simultaneous existence of the paludal with many other morbid poisons.

Modes of Absorption.—It is apprehended the paludal miasmata are absorbed in all cases by the mucous mem-

branes either of the lungs or alimentary canal; and being absorbed, that they mingle with the blood. Dr. Russell, at least, gives a case of a pregnant woman, labouring under ague, shaking at one hour while her fœtus shook at another, and that they were both cured by bark.

Period of Latency.—The period of time after exposure to the cause that the poison may lie latent, varies according to its intensity and the state of the recipient. In the West Indies men have been brought to the hospital ill of fever the night after landing; but the more usual period in tropical countries is three, four, or five days, to a fortnight. In more temperate climates the period of latency is usually much longer. The minimum of time may, perhaps, be as short as in the West Indies; but more commonly the poison lies latent for many weeks, and sometimes for many months. On the return of our troops from Walcheren great care was taken to quarter them in situations remote from all known sources of marsh miasmata; yet fresh cases continued to occur as late as five, six, eight, nine, and even ten months afterwards. It is probable, therefore, that cases of ague received into our hospitals in winter and early in the spring must have been contracted in the preceding summer or autumn.

Pathology.—The theory of this disease is, that the paludal poison is absorbed and infects the blood, and after a period of latency, more or less long, produces, according to the dose, functional disorders of the great nervous centres, terminating in the phenomena either of intermitting, remitting, or else that peculiar form of remittent termed yellow fever. These fevers may exist without any alteration of structure being set up, and the patient often dies from the severest forms, with hardly a trace of disease being discoverable. In the milder forms of these fevers, however, when the disease is prolonged, the poison acts upon and disorganizes a greater number of organs and tissues than almost any other poison, as the liver, spleen, lungs, heart, brain, and the serous and mucous membranes of the body generally. The specific actions, then, of the poison, within certain limits, may be said to be in the inverse ratio of intensity. The affections of the liver and spleen also vary greatly, according to the country; for in some parts of India the spleen is the organ chiefly affected, while in other districts it is the liver; the nature of the country, perhaps of the soil, impressing evidently some peculiar character on the poison.

The patients labouring under intermittent fever, or a minimum dose of the poison, in and about London, generally recover under medical treatment without any manifest derangement either of structure or of function of any organ or tissue. When, however, the disease is neglected, the poison may fall on the liver, and occasion merely disordered function of that organ, as jaundice; or it may produce inflammation, of which jaundice may or may not be a symptom; and this inflammation may be acute or chronic, diffuse or suppurative. If a liver, previously healthy, becomes the seat of diffuse inflammation, it is of the deepest hepatic tint, and loaded with blood; and we find it also often greatly hypertrophied, filling the abdominal and pelvic cavities, and according, perhaps, as the inflammation is acute or chronic, either greatly indurated or else so softened as to be easily broken down. In a few instances this inflammation may terminate in abscess, and generally of the usual phlegmonous character. On the contrary, if the liver be previously diseased, its colour, even when the seat of abscess, or otherwise most acutely inflamed, may be of the palest yellow, and its texture sometimes so soft and broken down that the blood-vessels may be dissected out with the fingers, or else so indurated as to form a muscular shapeless mass, of varying magnitude. When abscess forms it may rupture into the duodenum, or into the cavity of the abdomen, or it may point externally.

The paludal poison also often produces structural alteration of the spleen. In these cases that organ has been found sometimes so enlarged as to weigh 10 to 30 lbs., greatly exceeding the liver in size, while in other cases it is sometimes even less than natural. In consistency, also, it varies from a state of almost fluidity, a mere bag of blood, to a hardened mass, with a distinct indurated edge. It is also sometimes the seat of abscess.

When the poison falls on the peritoneum its functions may be alone deranged, so as to produce dropsy. Every form of peritoneal inflammation, however, may precede or accompany the ascites,—as the diffuse, the serous, the adhesive, or the purulent; and these forms may be either acute or chronic, but more commonly they are acute.

These are the most usual alterations of function and of structure in the mild paludal fevers seen in and about London in the present day; and in estimating the relative frequency of these secondary affections, ascites is the most common, then jaundice; while peritonitis, hepatitis, and splenitis are less frequent, and occur, perhaps, in nearly equal proportions.

The pathological phenomena which a medium dose of the poison produces, or that which gives rise to severe intermittent and mild remittent fever, are much more severe, and extend over a greater number of organs. Sir Gilbert Blane, in his observations on the Walcheren fever, remarks, that the structural derangements were more frequent, swelling of the liver and spleen then taking place in a very few weeks; which in England seldom occur, except under a long continuance of the disease, or after frequent relapses. The morbid anatomy, however, also extends to the mucous membrane of the stomach, which in a few instances was inflamed and ulcerated, and the ulcers had generally a sharp perpendicular edge, as if made with a punch. In such cases also as died dysenteric the large intestines, and more particularly the sigmoid flexure and the rectum, were always much contracted, thickened, inflamed, and ulcerated; the ulcers being often so numerous and so confluent that the whole inner surface of the gut appeared in a state of granulation.

The peritoneum was also very generally inflamed, especially that portion which covers the different organs, caused perhaps by extension of the morbid irritability of those parts, and from this circumstance the different viscera often adhered to each other and to the walls of the abdomen; and sometimes it also happened that an encysted abscess formed between the adherent surfaces. In other cases the intestines were often seen floating in serum or pus, or else were glued together. In dropsical and dysenteric cases the peritoneum was unusually thickened, while abscess occasionally formed in the folds of the mesentery.

The serous membranes of the chest were also frequently the seat of disease. Sometimes a dropsical effusion filled the cavity, in other cases the pleura pulmonalis was almost universally adherent to the pleura costalis, while in others the whole surface of the membrane was covered with recently effused coagulable lymph. In some cases the anasarca was general, but

the more remarkable effusion of serum was around the epiglottis, when it formed a large tumor, sometimes as big as a turkey's egg, completely closing up the rima glottidis and suffocating the patient. The epiglottis also was in some cases found ulcerated and thickened. Bronchitis and laryngitis were not unfrequent, while the substance of the lung was sometimes the seat of severe inflammation, terminating either in the red or grey hepatization, or with effusion of serum.

The heart itself did not always escape the inroads of this destructive poison, for the pericardium was frequently found inflamed and covered with lymph, or else the seat of serous effusion. It was even seen ulcerated, and its adipose membrane œdematous.

The membranes of the brain were also often the seat of much inflammation, lymph or serum being often effused between them, while much water was occasionally found in the ventricles. The substance of the brain also, especially in dropsical cases, was so soft as hardly to bear the knife. Such are the destructive effects of a medium dose of paludal poison.

The maximum dose of the paludal poison producing the severer forms of remittent and of yellow fever does not occasion the same amount of disorganization. In this respect the paludal poison follows the great law of poisons generally, or, the dose being in excess, the patient falls before sufficient time has elapsed for the poison to set up its specific actions. "In cases of the Wynaad fever," says Mr. Walsh, "though black vomit and yellowness of the eyes were frequent, and they terminated fatally in four or five days, there was scarcely any vestige of local injury or of disorganization." Mr. Amiel also affirms, that the rapid progress and short duration of the Gibraltar fever left no time for visceral obstructions to be formed.

As a general principle, in the West Indies, in Africa, and indeed in all countries in which remittent fever is of the highest degree of intensity, the traces of diseased structure are always trifling, and limited to the stomach, the brain, the liver, or the spleen. When the stomach is affected, the mucous membrane of the pyloric orifice is for the most part inflamed, easily detached, and sometimes ulcerated. The contents of the stomach also are either a viscid mucus, or that black melanic matter which is sometimes thrown up, or else pure blood. In 7-10ths of those examined at Barcelona, in 1821, the stomach contained melanic matter, like soot mixed with water, or coffee-grounds, while in 1-8th it contained pure blood. The duodenum and small intestines, and not unfrequently the gall-bladder, were also inflamed. Dr. Barry and Mr. Rufz speak of having observed Brunner's glands to be enlarged, but never Peyer's. The small intestines also are filled with the same matters as the stomach, but more viscid and thicker, and more resembling tar; and in the large intestines these matters were often mixed with clotted blood. The liver and spleen have usually been found healthy. Louis states, that in the epidemic at Gibraltar he found the liver of a pale yellow colour, a circumstance he considers to be the great pathognomic sign of the disease. It is probable, however, that this generalization is hasty, for it was not observed by our own officers, and has since been found wanting in the epidemic at Martinique. The substance of the brain is in general healthy, and sometimes a little softened, while the membranes are only occasionally inflamed with the usual effusion of serum.

Symptoms.—The paludal poison, according to the dose, or else according to the susceptibility of the party, produces two distinct varieties of fever, or the intermittent and remittent fever. The former has many varieties, denoted by the different periodic intervals which elapse between each paroxysm, while the varieties of the latter are denoted by the greater length of the febrile paroxysm, and by the greater gravity of the disease alogether. The varieties of intermittent fever are,—

Febris intermittens quotidiana,
Febris intermittens tertiana,
Febris intermittens quartana.

The varieties of remittent fever are,—

Febris remittens mitior,
Febris remittens gravior,
Febris remittens gravior cum ictero.

The relative frequency of these different types varies greatly in different countries, as also their aggregate amount. In the Windward and Leeward command the admissions for intermittent fever form about two-fifths of the total number admitted labouring under fever. But it does not prevail equally in all the settlements belonging to this command, but is principally confined to the low marshy settlements of Demerara and Berbice, where it has been a great source of inefficiency, particularly since 1830; the number attacked in the course of the year having been often equal to the whole force of the colony. Intermittents also are very common in Trinidad, owing to the vicinity of the barracks to the marshes; but in the other islands they are comparatively rare, and in some almost unknown. In Jamaica intermittents form about one-seventh of the whole number, while at Bona, in Africa, they are as 3 to 2, and again in the Ionian Islands they are about 1 in $3\frac{1}{2}$ nearly.

The minimum dose of the paludal poison gives rise to the simplest and least dangerous form of the disease, or to *intermittent fever*, of which the varieties are distinguished from each other by the interval of time which elapses between each paroxysm. For instance, when the paroxysm returns every 24 hours it is termed a *quotidian*, when every 48 hours a *tertian*, and when every 72 hours a *quartan;* and these primary types have been extended by early writers to every period comprised within a mensual or bimensual period.

Of these primary types it has been supposed that in this country the tertian is by far the most common, then the quartan, and lastly the quotidian. But this law is by no means general, for M. Maillot treated 2354 cases of intermittent fever occurring in the French army in occupation of a portion of the northern shores of Africa, and he found of that number 1582 were quotidian, 730 tertian, and 26 quartan. In the Peninsular war the quotidian was likewise the prevailing type, and at one time they were in the proportion of 16 to 1 of any other type. In the West Indies the tertian and the quartan are only about one-twelfth of the whole number of intermittents treated, the rest being quotidians.

Most authors who have written on intermittent fever have stated that the accession of the quotidian paroxysm occurs early in the morning, that of the tertian about noon, and that of the quartan in the afternoon, between 3 and 5 o'clock. But to this law there are many exceptions; for, according to Maillot, of 1582 quotidians 1089

occurred from midnight to midday, and 493 from midday to midnight; of 730 tertians 550 occurred from midnight to midday, and 180 from midday to midnight; out of 26 quartans also 13 were seized from midday to midnight, and 13 from midnight to midday. As the most general conclusion, the paroxysm returned in a great majority of the quotidian cases from 10 to 12 o'clock, and in the tertian from 9 to 12 o'clock.

The febrile paroxysm, or fit of intermittent fever, has three stages: a cold stage, a hot stage, and a sweating stage. These three stages are not necessarily of an equal duration, but vary greatly in different cases. The duration of the cold stage is from a few minutes to five or six hours, and in general, if the disease be severe, the shorter the cold stage the longer the hot stage. The hot stage may last from half an hour to any period less than 24 hours. The sweating stage is generally shorter than either of the former, and sometimes does not exist at all. The rule, however, is, that the quotidian has the shortest cold stage and the longest hot stage; the tertian a longer cold stage and a shorter hot stage than the quotidian; while the quartan has the longest cold stage and the shortest hot stage of all the varieties.

The disease may be sudden in its attack, and without previous illness, but more commonly it is preceded by general indisposition, headache, weariness, pain in the limbs, thirst, loss of appetite, white tongue and frequent pulse, high coloured urine and dark coloured discharge from the bowels. These prodromes are accompanied with well-marked exacerbations and remissions of fever, displaying a periodic tendency. After this feverish state has lasted from four days to a fortnight, the patient is seized with severe rigor, and the ague is manifested. The phenomena of a paroxysm are the following:—

The paroxysm, like the disease, may be of sudden invasion, and the patient in good health up to the time of attack; or it may be preceded by languor, debility, frequent yawnings, and great unwillingness to make the least exertion. In whichever way the cold stage begins the patient experiences first a sensation of coldness of the extremities, then of the back, and lastly of the whole body; at the same time the nails turn blue, the features shrink and become pale and sharp, and if the case be severe the whole body shrivels up, turns purple, and is "goose-skinned." The coldness increasing, the motor nerves of the fifth pair are affected, and the teeth begin to chatter; and this tremor extends to every muscle, till the whole body shakes with rigor. Cough, dyspnœa, and oppression of the præcordia now occur, with a painful sensation round the temples and down the back. The patient also often suffers from nausea and vomiting, and the latter symptom is speedily followed by the hot stage. When the cold stage has lasted a period varying perhaps from half an hour to two hours and a half, a re-action takes place, accompanied by partial warmth, or flushings. These extend, and at length the whole body acquires a heat greater than natural, or from 105° to 107°. As the heat returns so also does the colour; and the body, especially the face, becomes now preternaturally swollen and red. The hot stage being now formed, the heart and arteries beat with unusual violence, and headache, with a frequent full pulse, and all the distressing symptoms of continued fever, are present. "The mean duration of this stage is from three to eight hours. At its close a gentle moisture breaks out, first on the forehead, and thence extends till the patient lies in a general sweat, sometimes so profuse as to soak the bed and linen as completely as if they had been dipped in water. After the sweat has continued to flow for some time the fever gradually abates, a state of apyrexia ensues, and the paroxysm is terminated, and, a sense of exhaustion excepted, the patient feels restored to health. Sometimes, however, he continues pale, debilitated, and incapable of all exertion, till, on the recurrence of the paroxysm, the symptoms just described are repeated.

Upon the approach of the attack the pulse is slow and feeble, but as the sense of coldness increases it becomes small, rapid, and irregular. When the hot stage forms it becomes full and strong, and on the sweat breaking out it again becomes soft, less rapid, and at length natural. In the course of the paroxysm there is a considerable change in the urine, which, during the cold stage, is abundant, colourless, and without sediment. In the hot stage it is high coloured, but still void of sediment; but as soon as the sweat begins to flow a sediment, commonly lateritious, is deposited, and this deposition continues for some time after the paroxysm is terminated. The tongue, in mild forms of the disease, is clean in the cold stage, white in the hot stage, and again cleans after the sweat has flowed. In severe cases the tongue is white during all the stages, and also during the apyrexia, while in the worst cases the tongue is brown in all the stages. Excepting some unusual instances, attended throughout with diarrhœa, the patient seldom passes a stool till towards the close of the paroxysm, when it is generally a loose one. It frequently also happens during the cold stage that tumors subside, or ulcers dry up, but the tumor generally reappears, and the ulcers discharge as soon as the sweating stage is formed.

The paroxysm of intermittent fever, of whatever description, is conventionally considered to terminate in 24 hours; for, if prolonged beyond that time, it is termed remittent fever. The duration, however, varies in different types. Dr. Brown conceives the mean length of a quotidian to be 16 hours, that of a tertian 10 hours, and that of a quartan 6 hours. In London, however, this calculation is greatly in excess: for, in the majority of cases, the paroxysm, whatever be the type of the fever, seldom exceeds two to six hours, and consequently the mean is hardly more than four hours.

It is seldom that intermittent fever, of whatever type, consists of a single paroxysm, for usually it recurs many times, so that the whole duration of the disease, if left to nature, would be extremely long. Horace speaks of its lasting five months, while Sydenham extends this period to six months, stating, if bleeding has been used it often lasts for 12 months. Under the present improved treatment in London the disease is generally terminated after a very few paroxysms, perhaps three or four, the patient being now removed to an atmosphere free from the paludal poison. If the disease be neglected, the fever becomes complicated with dropsy, peritonitis, hepatitis, splenitis, inflammation of the lungs, or with dysentery, then the symptoms peculiar to those disorders will be added.

The Symptoms of Remittent and Yellow Fever.—A higher degree of the paludal poison, or a medium and a maximum dose, produces remittent fever, and its more intense form, yellow fever, for the latter disease differs in no respect from the former, except in the jaundice, which accompanies it, and in the remissions being less

complete. There are so many grades of intensity in remittent fever, varying as it does from a severe intermittent to yellow fever, and so many different modifications impressed on it from the great variety of country by which the poison is generated, that it is extremely difficult to generalize the phenomena.

The severer forms of remittent fever may be preceded by languor, restlessness, or chilliness, symptoms which usher in a short cold stage; but in other cases the attack is sudden, and the patient, for instance, immediately after a hearty dinner may be seized most unexpectedly with faintness, vertigo, confusion of thought, and these almost without a rigor; a hot stage, usually of much greater intensity than that which accompanies the worst forms of intermittent fever, follows.

The hot stage is usually marked by much cerebral affection: as severe headache, a painfully acute state of every sense, an injected state of the conjunctiva, and great action of the carotid arteries. These symptoms are frequently accompanied by delirium, sometimes of a violent character, while in other cases the patient is oppressed with great drowsiness, lethargy, or coma. The stomach also often is the seat of great pain and uneasiness, followed by vomiting, and the matters vomited are either colourless or bilious, or else blood. The duration of this paroxysm varies considerably, and when the disease is mild it may terminate in six or seven hours, but if severe it may last 15, 24, 36, or even 48 hours; and Dr. John Hunter once saw a case in which there was no remission for 72 hours. The fever, however, at length remits, sometimes with sweating, but at other times without any sensible increase of perspiration.

The duration of the remission which follows is as various as that of the hot stage. Sometimes it does not last longer than two or three hours, more commonly it extends to 10, 15, 30, or even 36 hours. The fever then returns, and in some cases assumes a quotidian type, and has an exacerbation every day, and perhaps nearly at the same time, yet more frequently there is no regularity in the times either of its accession or remission.

The second paroxysm is always more severe than the first, if the progress of the fever has not been checked during the remission, and usually neither any cold stage, rigor, or even chilliness precedes it. On the other hand, all the febrile symptoms run much higher, the skin is hotter, the pulse more frequent, the headache greater, the senses more confused, and the delirium or coma, when that exists, more violent in degree and more sudden in its accession; and these symptoms sometimes persevere with or without the black vomit, till they terminate perhaps in convulsions, and at length in death.

This severe remittent fever is sometimes accompanied by a symptom which has given a name to this disease as though it were a distinct species, or a yellowness first of the eyes and then of the skin, and hence the term "yellow fever." The yellow fever, however, is simply a remittent fever, with the addition of jaundice, a variety remarkable only for its great severity, and for the sudden aggravation of all the symptoms. The jaundice may occur in the first paroxysm, accompanied by a sudden and almost total loss of strength, by stupor, subsultus tendinum, pain and irritability of the stomach by incessant retching, and that retching the black vomit, and so violent or profuse that the patient sometimes dies in twelve hours. More frequently, however, the jaundice does not appear till the second or third paroxysm, and the patient then sinks with all the bodily and mental affections incident to the last stage of typhus. Occasionally, however, the course is different.

Dr. Wilson has remarked, that the term insidious has often been applied to the West India fever, and with great propriety: for he states, that while the poison is frequently sapping the powers of life there is often little to inform us of the mischief that is going on within, so that the symptoms frequently do not prepare us for the fatal issue. "In the midst of our security," he adds, "and when we are imagining all is going on well, we are shocked by the sudden eruption of the black vomit, or the accession of profound coma, rapidly producing death." The insidious nature of the severe forms of paludal disease was remarked also by Dr. Barry at Sierra Leone. "The state of the patient's mind was also most peculiar, for the poor sufferer appeared entirely unconscious of his hopeless state, and generally expressed himself as being much better, until, the vital heat receding from the surface, dissolution took place, sometimes preceded by violent straining of the eyeballs and incoherent expressions, or else by some convulsive motions. At Gibraltar the patients sometimes died without taking to their beds, or "on foot," as it was termed. The following case is given by Louis: —Dr. Matthias, who died at Gibraltar after an illness of four or five days, experienced no other symptoms than severe pains in the calves of the legs and a suppression of urine. He had no nausea, and did not vomit, and his mind was clear during the whole course of the disease. He noticed, however, the suppression of urine, dictated three or four letters to a friend, begged him to write rapidly the last, that he might sign it, then devoted a short time to an affectionate intercourse with this friend, and soon after, becoming speechless, he thanked him by a sign, and in a quarter of an hour was dead.

In the interval of the paroxysm the patient in some few cases still retains some power, but more generally the prostration is great. Dr. Arnold says, that there is no disease in which the muscular power is so much impaired from the commencement to the termination, particularly if the invasion be brought on by syncope. Dr. Davy also says, "When I reflect on the severe cases, no other disease occurs to me, excepting spasmodic cholera, which gives such an idea of the energies of the constitution being overpowered as if by a subtle active poison."

This disease is in a few instances fatal within 24 hours, often on the third or fourth day, and in almost every case the patient, if he does die, dies before the seventh, or at most the ninth day.

Diagnosis.—If one paroxysm constituted an ague, there are many diseases which might be said to simulate intermittent fever, as erysipelas, pneumonia, and almost every acute affection; but the absence of a second paroxysm, and the formation of an entirely different disease, readily distinguish them. The last stage of the mild form of remittent fever cannot always be distinguished from typhus.

Prognosis.—No patient ought to die in this country from simple intermittent fever, provided he can be removed from the marshy district.

The mortality from intermittent, remittent, and yellow fever, according to the reports of the sickness and mortality occurring among the troops in the West Indies, the Mediterranean, and in North America, and presented to both Houses of Parliament, is as follows:—

Deaths from	Windward & Leeward Command.	Jamaica Command.	Gibraltar.	Malta.	Ionian Islands.	Upper Canada.	Lower Canada.
Intermittent fever .	1 in 169	1 in 163	1 in 60	1 in 311	1 in 236	1 in 1143	1 in 535
Remittent fever . .	1 in 9	1 in 8	1 in 11	1 in 24	1 in 22	1 in 11	1 in 5
Yellow fever . .	1 in $2\frac{1}{3}$	1 in $1\frac{1}{3}$	1 in $1\frac{2}{3}$	..	..	..	..

When troops are on actual service in tropical countries the mortality from severe remittent and yellow fever is often enormous. In the attack on Carthagena the troops remained on shore but 10 days, yet on re-embarking the sick were to the healthy as two to five, and ultimately one-fourth of the whole number died. In the late expedition to the Birman Empire, within three months of taking possession of Rangoon, more than 3000 men had died, or more than one-half the entire force.

Treatment.—There would have been no end to the miseries inflicted on mankind by intermittent fever had not the very antidote nature seems to have provided against the mild form of paludal disease been at length discovered. The plant cinchona, as well as its sanatory properties, is said to have been known to the natives of Peru long before the discovery of America, but to have been kept secret by them out of hatred to the Spaniards. The Jesuits, however, became acquainted with its specific virtues, and employed it in 1638 in the cure of Count El Cinchon, a Spanish peer and viceroy of Lima. The remedy was successful, and it became celebrated throughout Europe. It was first exhibited in powder in two-drachm doses twice a day, and was subsequently given as a decoction, as an infusion, as a tincture, and also as a wine, the bark being steeped in port wine. Of these various modes it was, however, determined that in severe disease the powder, when the stomach is not too irritable to bear it, is the most efficient, and the dose of the pulvis cinchonæ has been fixed by general usage at a drachm for an adult; and this dose given every four or six hours has been found, when persevered in for three or four weeks, or longer, to cure the great majority of intermittents in and about London. Occasionally this dose has been found inefficient, and it became necessary either to increase the quantity or to augment its efficiency by additional stimulus. Drs. Fordyce and Huck increased the quantity so far as to give half an ounce, and even an ounce, for a dose, and a few cases were cured by this means; but the stomach so often rejected this crude mass, and the incessant vomiting which often followed so constantly retarded the convalescence of the great majority thus treated that this excess of dose has in general been abandoned. It was then found that an additional stimulus was generally more efficient than an increased quantity of cinchona, and that a scruple of Cayenne pepper added to each drachm of bark frequently succeeded in curing an ague, when bark alone had failed. Sometimes, however, even bark combined with Cayenne pepper (piper Indicum) was inefficient, and in these obstinate cases opium was found to be an admirable adjuvant, and the triple compound of pulveris cinchonæ ʒ j. piperis indici ℈ j. c. opii gr. j. 4tis horis has in general been found an adequate remedy for the most intractable intermittents met with in London.

The occasional failure of crude bark, notwithstanding the use of many auxiliary remedies, rendered some further additional power a great desideratum, and we owe to Pelletier and Caventou the discovery and isolation of *quina*, one of the alkaloid principles of cinchona, and which endless experiment has shown to be the real antidote to the paludal poison, when of such intensity as merely to produce intermittent fever; and the introduction of this substance into medicine has rendered all other modes of treatment, when the disease is not as yet complicated with organic lesion, unnecessary, at least in London. Quina sits easily on the stomach, even in large doses, and about five grains are esteemed equivalent to one drachm of crude powdered bark. There are two modes in which it may be exhibited, or in small and repeated doses at short intervals, or else in one large dose once in 24 hours. The latter method, however, seems the most preferable, for on a comparison of many cases treated by one, two, to five grain doses given every second, fourth, or sixth hour, with others treated with ten grains in one dose every night, it has resulted that one large dose of quina has effected the cure of the patient in less time than double the quantity given in small and frequent doses; thus not only demonstrating that the large dose is more beneficial to the patient and more economical of quina, but also that the cure must be effected rather by the impression made on the nerves of the stomach, than by the quantity absorbed. The disulphate of quina is the preparation generally used, and is probably the best; and 10 grains of this substance given every night often stops the fever at once, more commonly after three or four paroxysms, and always in the course of a very few days. It is unimportant whether this substance be given in pills, out of camphor mixture, or in solution by means of dilute sulphuric acid, in the proportion of one drop to each grain of the salt. It is necessary to add, however, that whether bark or quina be exhibited, or whether the dose be large or small, the patient should continue its use for a fortnight or three weeks after the last paroxysm, in order to guard against relapse, for the diseased actions appear to be suspended for some time before they are cured. It is desirable, perhaps essential, also, that the patient should be removed from every source of the paludal poison. The medicine should be given during the state of apyrexia.

When intermittent fever becomes complicated with secondary affections of the paludal poison, so that inflammation of the peritoneum, of the pleura, or else dropsy of those membranes, ensues, the treatment by quina must be either modified or abandoned. If inflammation be the result, local or general bleeding must be had recourse to, yet not to any extent, for as the inflammation depends on the action of a poison, the utmost we can hope to effect by that operation is to moderate the symptoms. This limited bleeding is to be followed by the exhibition of mercury, so as to affect the mouth. Five grains of calomel, given once or twice in the 24 hours, is generally sufficient, but the quantity and frequency of the exhibitions must be proportioned to the severity of the attack, and there are very few cases which do not yield as soon as the gums are

affected. The beneficial effects of calomel are indeed so striking, that a much greater latitude may be allowed than in similar cases of simple phlegmasiæ, with respect to refraining from bleeding.

If the secondary action of the poison produces merely disordered function of the serous membranes, ending in dropsy of the abdomen or chest, bleeding is unnecessary or injurious, while mercury is still the most useful, and indeed essential agent; for few cases of paludal dropsy resist, in London, the action of five grains of calomel, repeated every night till the mouth is affected; and this medicine is much to be preferred in these cases to squills, elaterium, digitalis, or any of the large class of neutral salts, which are found so useful in the simple forms of dropsy. It is necessary, should intermittent fever and dropsy co-exist, that quina be exhibited in combination with the calomel; if otherwise, it is unnecessary.

When the paludal poison so deranges the functions of the liver as to occasion jaundice, mercury is still the only beneficial remedy; nor are large quantities of it necessary, for five grains of the pilula hydrarg. or two grains of calomel every night, are in general all that is necessary to remove the complaint. In this case, should the febrile paroxysm continue, the one large dose of the disulphate of quina every night should be still exhibited.

It is unusual to meet in London, in the present day, with intermittent fever accompanied by *acute* hepatitis or splenitis, so that we have few opportunities of determining the most satisfactory modes of treating them; but it is apprehended that bleeding and mercury, or mercury and the disulphate of quina, will, according as the fever is or is not present, be found the most efficient remedies, at least for hepatitis, whether acute or chronic. We possess, however, no satisfactory mode of treating acute splenitis, and when that disease becomes chronic, the case is still more hazardous. It seems determined that mercury and bleeding in these cases are both decidedly injurious, so much so that the Indian practitioners employ a spleen powder, composed chiefly of equal parts of sulphate of iron, of cream of tartar, and of *jalap*. In this country that compound has not supported the character it has acquired in India, and some few apparently hopeless cases have been successfully treated by the iodide of potassium, gr. viij. ter die. Dr. Williams, of St. Thomas's Hospital, has published some few cases in which the bromide of potash, in doses of five grains, out of camphor mixture, appeared to have considerable influence over these large and indurated spleens. After the ague has been cured there often remains a troublesome and protracted nervous affection of one side of the head, bounded by the sagittal suture, though not unfrequently occupying the occipital portion. A continuance of quina is more useful in removing this affection than bleeding, cantharides, or blisters.

Cure of Remittent Fever.—Quina is unquestionably a most efficacious remedy, indeed a specific, in the cure of simple intermittent fever, and bleeding and mercury in removing most of its consequences. It is to be regretted, however, that these remedies, either separately or combined, are much less efficacious in the cure of the severe remittent forms of the disease; yet, as they are the most powerful agents we possess, it is desirable to ascertain their respective values.

The ancients generally bled, but most unsuccessfully, in intermittent fever; and Sydenham, Morton, and Cleghorn immediately abandoned that operation on the introduction of bark. Bleeding, therefore, having failed in the mild forms of the disease, little could be expected from it in the more severe ones; and this operation, when practised on a large scale, appears to have effected little good. "In the Walcheren expedition," says one of the medical officers, "I bled patients and saw others bleed them, but it was only to see them die." In the Rangoon expedition bleeding was the favourite remedy, yet in less than three months one-half of the British force were laid in their graves. Mr. Ameil says, that at Gibraltar bleeding, both in large and small quantities, was tried, and under the most marked indications, but "I experienced no favourable results." In the treatment of the French troops employed in Africa, M. Maillot says his patients became so frequently delirious or comatose, and in this state were carried off in a few hours, that he entirely abandoned the practice. Dr. Davy also considers bleeding, in the remittent incident to the Ionian Islands, to be decidedly injurious. In the East Indies, in the West Indies, and in Africa, and indeed to whatever quarter we turn, we find the large majority of practitioners adverse to the practice of bleeding. Many speak of it as not producing much mischief, if moderate in quantity and early in its application; while only a few advocate its extensive use. It may be affirmed, then, as a general principle, that bleeding to any amount is either inefficient or injurious in every form of paludal fever. Some depletion, however, either by the lancet, cupping, or leeches, may be necessary to save a threatened organ; but bleeding, carried to the extent which might be borne in the simple phlegmasiæ, seems quite unwarranted, not only by the laws of poisons, but by the experience of the profession generally.

The property which mercury possesses of controlling many of the secondary affections in intermittent, has caused it to be extensively employed in the cure of the remittent and yellow fevers, but with extremely questionable success. In the Walcheren expedition it was largely used and fairly tried, yet it was admitted to have most egregiously disappointed the hopes of the medical officers. It appears, also, to have been used with an equal or greater profusion in the Rangoon expedition, and with what lamentable result has been already mentioned. In the West Indies Dr. Chisholm has given as much as 6000 grains of this metal, externally and internally, in a single case of yellow fever; and in America it has been almost equally largely employed. It has appeared to result, that mild cases have recovered under this treatment, as they would, perhaps, have done under any other; but in severe cases it has, for the most part, been unsuccessful, and in many instances palpably injurious, and is now more commonly used as a purgative than as an antidote.

Bleeding and mercury, either separately or conjointly, having been proved to be inefficient, crude bark was very generally used between the tropics in the cure of remittent fever, sometimes throughout the disease, and at other times only during the intervals; and it has been asserted that more recoveries took place under this treatment than under any other; still, however, the great irritability of the stomach often caused it to be rejected in every stage, and the life or death of the patient often appeared to turn on the quantity of wine or other nourishment that could be got down during the remission. The introduction of quina in the cure of this affection has had many prejudices and difficulties to

contend with, from the previous frequent failure of bark, but it promises to produce a new epoch in the treatment of the remittent fever. In the East Indies it has been found to possess the means of controlling that disease to an extent hitherto deemed impossible. In the West Indies, also, it is now generally used, and its great powers admitted; and on the coast of Africa, in the treatment of the French troops, M. Maillot conceives he has reduced the mortality from one in four and a-half to about one in twenty-two, by the use of this remedy. The dose, however, given by this gentleman is enormous, for in bad cases he gives from one to two scruples by the mouth, and 60 grains as an enema; and in this manner he has in several instances given as much as 148 grains in the 24 hours. These large doses he states to have been generally successful, and never produced any engorgement of the viscera, dropsy, diarrhœa, or other unpleasant symptoms.

It is impossible, after such evidence, to doubt the great value of quina in the cure of remittent fever. The battle, however, still rages between those who would still treat this disease symptomatically, or by moderate bleeding, effervescing draughts, purgatives, and also supporting the patient in the remission by wine, strong broths, and those who prefer the specific remedy. The increasing intelligence, however, of the medical profession, will in a few years determine the circumstances, and the time, and the dose in which this remedy should be exhibited; and if we make a due allowance for that severe form of disease which renders all remedies powerless, we shall eventually see it occupy a high place in the cure of remittent fever.

Dietetic Treatment.—There is something extremely inimical in an animal diet in every case of disease from a morbid poison; and consequently, though broths may be useful and necessary during the intermission or remission, the diet of the patient from the commencement till the termination of the disease, whether remittent or intermittent, should be strictly antiphlogistical, and limited to a milk diet, slops, vegetables, and jellies, and, according to the discretion of the practitioner, to some wine.

Preventative Treatment.—The question of prevention necessarily involves the doctrine of the contagious or non-contagious nature of paludal fever generally. The milder forms of paludal fever are certainly not contagious; for the London Hospitals often contain a considerable number of cases of intermittent fever; yet in no well-authenticated instance has that disease been known to spread to any patient in the ward, or to any medical or other attendant. On the return of our troops from Walcheren, labouring under every grade of remittent and intermittent fever, not one orderly, nurse, or medical attendant suffered from either of these fevers, who had not been previously exposed to the action of the paludal poison,—the contrary, it will be remembered, of what happened when they returned suffering under typhus from Spain.

In the West Indies it is the common practice to send convalescents from the towns to the mountains; but no instance is known of yellow fever spreading in those higher districts. In the West Indies, also, it was formerly the custom to place the fever as well as the other patients in contiguous beds, and even in tier over tier; yet no instance has been observed of the disease spreading. In the years 1796-1797, when the army under Sir Ralph Abercrombie suffered dreadfully in the West Indies from fever, the Inspector-General reported to the Army Medical Board the opinions of the medical officers on the staff on the subject of contagion, and that report states, "Contagion or infection has had little or no share in the mortality; and I must beg to add, that it has never occurred in a single instance to my observation."

The remittent and yellow fever rages in some parts of the East Indies as well as in the West Indies, yet the most intelligent officers have never remarked any appearance of fever from "a specific or contagious source in India." The evidence of the non-contagious nature of these diseases is equally strong on the continent of America. In the United states the fever hospitals have been built two or three miles in the country, and entirely beyond the local contaminated atmosphere of their respective cities. But in none of these establishments is there a single example of a person employed about the yellow-fever patients being attacked with this disease, unless he had been previously in an infected district. This appears to be so absolutely the case, that the President of the United States announced to both Houses of Congress in 1805, "That in the course of the several visitations of this disease, it has appeared that it is strictly local, incident to cities and tide-waters only, and incommunicable in the country, either by persons or by goods."

In addition to this testimony, many physicians, surgeons, and nurses have received the black vomit on their hands, faces, and clothes; some have inoculated themselves with it, and others have swallowed it, and yet no ill consequence has resulted. Beds, also, on which the yellow fever patient has died, have been occupied, still unpurified, by persons in health or patients labouring under other disease, and yet no unpleasant consequence has resulted. There seems no ground, therefore, for entertaining, in the remotest degree, the doctrine of the contagious nature of paludal fevers.

The only preventative treatment, therefore, is to avoid those localities which engender the paludal poison; and in Rome this precept is so well known that the wealthy inhabitants leave that city to reside during the summer in the country; while in Jamaica, from July to October, the only chance of avoiding an attack, in certain districts, is an early removal to the mountain residences in the interior. If, however, change of place is impossible, and we are obliged to reside within the range of the miasmata, we ought to avoid exposing ourselves to the night air, especially if we have previously suffered from the disease, for the tendency to relapse is great. It should also be remembered that a relapse commonly takes place on days corresponding to the paroxysm; hence great caution is necessary to avoid exposure to cold, fatigue, improper diet, easterly winds, great mental anxiety, or other excitement on those days. Europeans embarking for the West Indies should remember that the autumn is the sickly season, while January, or the beginning of winter, is the season of greatest health, and affords the greatest chances of the constitution becoming *acclimatée*. The adoption of these precautions must undoubtedly diminish the chances of attack, but the only true preventive is drainage, and, where that cannot be effected, the keeping the waters of the marsh up to a given level by means of flood-gates or other mechanical contrivances.

Of the Paludal Poison.—*Dysentery.*

It has been seen that the paludal poison, according to its intensity, produces the various forms of intermittent, remittent, and of yellow fevers; but so singular are the laws of this noxious agent, that fever is not the only disease which it inflicts on the human frame, for, owing to some modification either of quality or quantity, the miasm also gives rise to dysentery, a disease which consists of an inflammation of the mucous membrane of the colon, and whose course and phenomena are frequently unaccompanied by any febrile symptom whatever. It is doubtful, indeed, if the morbid actions of this poison end here, or whether many forms of hepatitis and of splenitis ought not to be referred to its baleful influence. It is now intended, however, to treat of dysentery only.

Remote Cause.—It may be stated, as a general proposition, that there is no country where paludal fever exists that dysentery is not an endemic and prevailing disease. In the East and West Indies, in China, the Ionian Islands, Gibraltar, Malta, the Canadas, Holland, the coasts of Africa, as well as in many different parts of France, of the Peninsula, of the continent of America, and of the eastern parts of Great Britain, the prevalence of intermittent fever and of dysentery is notorious. This connexion is so intimate that a given number of persons being exposed to the action of paludal miasmata, as a boat's crew sent ashore in a tropical climate, the probabilities are that on the men returning on board part will be seized with dysentery, and part with remittent fever.

Paludal fever and dysentery, moreover, are not only conjoined in locality, but they often also co-exist, precede, or follow each other in the same individual, so that the fever frequently ends in dysentery, and the dysentery in remittent fever. This proof of the common nature of these diseases is corroborated by every writer of any celebrity, and more especially by those who have detailed the diseases of our armies. It seems distinctly proved, therefore, that dysentery is a disease of a specific nature, and originates in some peculiar modification of the paludal poison. It seems also determined that dysentery prevails generally in the inverse ratio of the intensity of paludal fever. In Jamaica, for example, where the white troops suffer in the large proportion of 91 per cent. annually from paludal fevers, the cases of dysentery are to those of fever as one to nine; while in the Madras presidency, where the troops suffer from fever in the much less ratio of only $30\frac{4}{10}$ per cent. annually, the cases of dysentery are to those of fever as 47 of the former to 30 of the latter. It appears also that dysentery is less common in the hotter than in the colder months, or arises under circumstances less favourable to vegetable decomposition. Thus in India and China it is from the middle of November to the latter end of February, or when remittent fever changes into intermittent, that dysentery greatly prevails.

Predisposing Causes.—Our knowledge of these causes is derived from what principally occurs in the military and naval service; and from the sufferings of the troops we learn that exposure to the night air, to wet, or to fatigue, together with the intemperance and improper diet incident to the life of a soldier, especially on active service in the field, have at all times been found to be powerful predisposing causes to dysentery.

The effects of *salt* diet in the production of dysentery being less known than the other predisposing causes, it may be as well to state, that by an experience of 20 years in the West Indies, it has been determined that in the Windward and Leeward Command, where the rations issued to the troops consist of salt provisions five days in the week, the mortality from diseases of the stomach and bowels among the officers is as two to four per cent., while that among the soldiers is as 20·7, or a tenfold ratio. On the contrary, in Jamaica, where salt provisions are issued to the troops only two days in the week, the mortality from the same diseases approximates so nearly between these two ranks as to be almost an equality. And corresponding facts to these have been observed in Gibraltar, on the coast of Africa, and at St. Helena.

In the navy also the same effects of ill-regulated diet have been observed. "In 1797," says Dr. Wilson, "the victualling (of the navy) was changed, greatly improved, and consequently immediate to the change the health of the seamen improved strikingly. Scurvy, typhoid fever, *dysentery*, and ulcer, which, up to the period of the change, had produced great havoc, became comparatively rare in occurrence and light in impression," and, it may now be added, are hardly known except by name.

The last appearance of dysentery in London was apparently owing to an insufficient diet, and occurred at the Penitentiary, Milbank, shortly after its completion. This prison is built on a marsh below the level of the Thames at high-water, the river being banked out by a narrow causeway. As long as the prisoners were allowed a full and ample diet they appear to have resisted the action of the paludal poison, and to have enjoyed good health. No sooner, however, was the quantity and quality of their dietary lowered than dysentery of a very fatal character broke out, and made it necessary to clear that establishment for a time of all its inmates.

There are few facts to enable us to determine the proportions in which the different ages suffer from dysentery, but the returns of the troops from the Mauritius show that the mortality from this disease falls principally on soldiers advanced in life.

	AGE.			
	18 to 24	25 to 33	33 to 40	40 to 50
Aggregate strength of 7 years	3892	5361	1215	300
Died of Dysentery	26	63	24	8
Ratio per 1000 of mean strength	6·7	11·8	19·7	36·6

Infecting Distance.—The paludal poison, when it produces dysentery, is subjected to the same laws as when it produces paludal fever. It is *absorbed* by the same tissues, *co-exists* with the same poisons, and the human

frame, instead of having its *susceptibility exhausted*, is unhappily liable to repeated attacks of dysentery, as well as of other forms of paludal disease.

Period of Latency.—The time which the poison lies latent in the system before it produces this form of disease is probably as various as that which precedes paludal fever. In many instances a large army has been affected in a few hours, while, from the many cases which occur on shipboard, and at long dates after the ship has left the land, it is probable the extreme periods may vary from a few hours to a few weeks, or even a few months.

Pathology.—The theory of this disease is, that the paludul poison, in a less dose than that which produces the mildest form of paludal fever, is absorbed by the mucous membranes and infects the blood, and after a given period of latency causes dysentery or inflammation of the mucous membrane of the colon. In a few cases likewise, either from continuity, sympathy, or a specific action of the poison, the mucous membrane of the stomach, or of some portion of the small intestines, becomes occasionally involved in the disease. The liver and spleen are also occasionally the seat of inflammation and of abscess, but whether from sympathy or a specific action of the poison is not determined.

The inflammation of the mucous membrane of the alimentary canal in dysentery may assume any form and degree incident to their structure, as the diffuse, the serous, the adhesive, the purulent, and the ulcerative, and it is not unusual to find most of these different degrees existing in different parts of the alimentary canal at the same time. These inflammations may also attack either the free or the adherent surface of the mucous membrane, or else its glandular structure; and these different parts may be either separately or conjointly affected. The pathological phenomena, however, vary in some degree, according as the patient falls in the acute or chronic stages of the disease.

When the patient falls in the acute stage of dysentery, or within the first few days of the attack, and while he is yet passing blood, mucus, or a loose watery lymph, or all of them, but before pus has appeared in the stools, the mucous membrane of the colon is found to be diffusely inflamed in patches varying from a shilling, or the palm of the hand, till the entire surface of the colon is affected. The colour of the affected part is of a deep cherry or venous red, and in some instances so nearly approaching to black as to appear sphacelated. This membrane is also thickened, and its cohesion so impaired that it appears almost gelatinous. The diameter of the intestines is also contracted.

The glandular structure of the alimentary canal is not necessarily affected in dysentery, still it is more commonly diseased; and in such cases the follicles are either enlarged and transparent, or else enlarged, hard, and opaque, according to the degree of inflammation. The contents of the colon in this stage are blood, mucus, and a loose watery lymph, together with a small portion of fæcal matter. Many early writers speak of having found scybalæ in large quantities, but modern observation has shown this circumstance to be extremely rare. The mesenteric glands are gorged, but seldom enlarged in this stage, while the mesentery itself often presents many red points, evidently the result of inflammation.

The second stage commences when pus appears in the stools. In this country suppuration seldom takes place without ulceration; but it is not improbable, from the quantity of pus passed by stool, sometimes many ounces, that pus may be secreted without ulceration: and Dr. Cornuel states he has examined cases in Guadaloupe in which no ulceration has been found, and yet pus in considerable quantity was contained in the colon. In this country the pathological character of the second stage is ulceration of the mucous membrane, and very commonly also of its glandular structure. The ulcers are usually situated at the free surface of the membrane, and they usually first appear as a number of small points, intensely red, which soften, and ultimately ulcerate. The ulcers may be deep or superficial, and their edge may be sharp and defined, as if made by a punch, or else broken down and almost diffluent. In dysentery, says Chomel, the mucous membrane often presents an appearance of erosion, which is an illusion; for if we gently pass the handle of the scalpel over it we detach a reticulated false membrane, and find the mucous membrane below it red and softened, something like gooseberry jelly.

As the disease advances the extent of ulceration is often quite astonishing; the whole of the mucous membrane, from the cæcum to the rectum, seems one universal series of ulcers, of which a few are occasionally found cicatrized, while others, perhaps, have burrowed so deeply as to rupture the peritoneal coat. The whole intestine is also thickened, contracted, and firmer than natural.

The adherent surface of the mucous membrane is rarely inflamed in the acute stage beyond that degree which impairs its cohesion. In the second stage, however, it is frequently the seat of a number of small abscesses, which give to the intestine that tuberculated appearance described by Pringle. The mucous membrane covering these abscesses at length inflames, softens, points, and bursts, and the pus escaping, abscesses of considerable depth are formed, and often in large numbers. The glandular structure is also frequently concomitantly affected and ulcerated.

When the small intestines partake of the inflammation the lower portion of the ilium is the part most commonly affected; and the mucous membrane of that part is either of a deep venous colour, or else *ardoisée*, according to the length of the disease, and it may at the same time be indurated or softened, thickened or ulcerated. In one case, Dr. Cheyne says, he found an exudation of lymph extending nearly over the whole of the jejunum.

If the stomach participates in the disease the mucous membrane may be merely diffusely inflamed, or of a red or violet-colour, its surface granulated, and its texture broken by the slightest touch. More commonly, perhaps, the colour of the mucous membrane is natural, but on its surface a number of ecchymoses or else small ulcers are seen with edges as sharp, clean, and perpendicular as if made with a punch.

The peritoneum, unless it has ruptured, is seldom either inflamed or thickened, but often presents many injected or ecchymosed points, which, when the intestine is opened, prove to be the base of some deep-seated ulcer. If the disease has terminated in dropsy the peritoneum is then commonly white, opaque, and thickened, or else injected, and perhaps granulated, the cavity containing a large quantity of albuminous serum.

The mesenteric glands are often found enlarged, red, and softened, sometimes resembling a clot of half fluid

blood, and sometimes they are said to have been met with as black as charcoal.

Sir James Macgrigor examined 22 bodies that had died of dysentery in the East Indies, and found the liver diseased in sixteen; and from this and similar circumstances, many pathologists have inferred that the liver was in all cases primarily affected, the dysentery being merely an accident, and caused by obstruction of the portal system. In the Peninsular war, however, the liver was often found free from the most trifling appearance of disease. At other times, indeed, it was altered in colour, but not changed in structure; and again, its colour being natural, its structure was found diseased, the viscus being either larger or smaller than usual, and indurated or softened, and sometimes the seat of abscess.

The spleen and pancreas are sometimes found diseased; and Mr. Twining notices the former as one of the most fatal complications of dysentery in the East Indies. These viscera are found either enlarged and softened, or enlarged and indurated, the spleen being sometimes the seat of abscess. It seems probable that the diseased states of the spleen must be owing to a specific action of the poison, for there does not appear to be any necessary connexion between that organ and the colon.

Symptoms.—Dysentery is divided by all authors into two stages. The first stage is that which precedes the appearance of pus in the stools. The second commences with the appearance of pus. The first stage is usually short, and seldom exceeds ten days or a fortnight, while the second stage may last from a few days to many months. It is important to mark this division into stages; for the chance of being able to cure this intractable disease depends on our being able to arrest it before the appearance of pus.

It is remarkable that a disease so fatal should in the first instance cause little disturbance of the constitution, so that fever is seldom present, and is always moderate when it is so. Dysentery is therefore essentially a *colitis*, and for the most part the symptoms are local. Its attack may be sudden, and the disease ushered in by a short rigor, but more commonly it is preceded by some diarrhœa, or a few bilious stools, causing a burning sensation of the anus.

The preliminary stage passed, the stools become more numerous, often 10 to 20 in the 24 hours, and according to Dr. Cornnel, sometimes in the West Indies they amount to upwards of 200 in the same period, the patient being incessantly "*sur le siége.*" The stools are passed in general with great effort, and consist of mucus, or a white glairy matter mixed with blood. By degrees the quantity of blood increases, till at last a pure black blood of loose consistency, and having sometimes a peculiar fœtid gangrenous odour is passed. This excretion is accompanied by much pain or tormina of the abdomen; by great tenesmus, and by great efforts at defæcation, so that at length procidence of the rectum may take place, and greatly add to the sufferings of the patient. In the West Indies, according to Dr. Cornuel, portions of mucous membrane, varying from a few lines to a few inches, are often passed in this stage, in a gangrenous state, when the abdomen becomes tense, meteorized, irritable, and the patient has an incessant desire to pass urine, which is always scanty, high coloured, and sometimes suppressed.

Inflammation, however, when strictly limited to mucous membranes, is not necessarily accompanied by pain, so that the patient is occasionally destroyed by acute dysentery, without suffering any abdominal pain. Pain, however, is a symptom which frequently exists, sometimes slight and transient, and relieved by pressure; at others severe and constant, and increased on pressure. Its more usual seat is the umbilicus, occasionally above or below it, or else to the right or the left of the mesial line; it often also extends down the thighs. The different complications of amount of pain, and number of stools, &c., cause dysentery in different countries, and in different persons in the same country, to vary from little more than diarrhœa, to the severest forms of colic, or even of cholera.

If the patient recovers, the symptoms are mitigated, the pain ceases, the number of stools diminish, and the flow of urine is restored. On the contrary, if the disease terminates fatally in this stage, hiccough, vomiting, a small and rapid pulse, and pale sharp features, denote the impending close of the disease. The intellect, however, is perfect, and the patient, often deploring the fate which he sees inevitably to await him, dies after a short agony.

At the end of a few days, however, pus may be seen in the stools, and the second stage be formed, and the patient is now plunged into the greatest danger. The pus passed in mild cases is often small in quantity, but more commonly it amounts to several ounces in the 24 hours, and may be voided with or without fæcal matter, blood, shreds of lymph, and lumps of a sebaceous substance, the number of stools continuing unabated. It is singular for how long a time the patients met with in London continue to possess much embonpoint, appetite, freedom from pain, and from all constitutional affection, notwithstanding the long-continued action of so powerful and exhausting a disease. At length however, the scene advances to a close, and the stools become more frequent, the tenesmus more distressing; pain, perhaps up to this period altogether wanting, becomes severe and constant, and occupies a large extent of the abdomen, or else perhaps an abscess of the liver silently forms without pain, and the first indication of its existence is its pointing, and the sinking of the patient. Whichever of these events takes place, the patient becomes rapidly altered and broken by his sufferings, is strikingly emaciated, and often earnestly prays to be relieved from a life disgusting to himself and entirely despaired of by others. On the contrary, the patient in a very few rare instances recovers, the local symptoms gradually yielding, till his health and strength are ultimately restored.

Diagnosis.—It is difficult, perhaps impossible, in the first stage, to distinguish dysentery from diarrhœa; but the blood, the number of the stools, and small quantity of fæcal matter passed, will, in times when dysentery is prevalent, allow the calm observer very closely to approximate to the true nature of the disease. When pus appears in the stools, unless some fistulous or other abscess has burst into the intestine, there can be no doubt of the nature of the affection.

Prognosis.—The prognosis depends much on the country in which the disease occurs, but in hot climates it is calculated that only 1 in 20 or 25 falls. On actual service these chances are much diminished. In the chronic forms it is supposed that three out of four recover; but this is a proportion much more considerable than is obtained in the London hospitals.

Treatment.—Perhaps there is no question on which

the profession are so much agreed, as on the inutility of large bleedings in dysentery. There are many authors who, with many limitations, recommend one general bleeding; but in almost every writer we find local bleeding the rule and general bleeding the exception; while many physicians omit both these operations.

As quina is unquestionably a specific remedy in the cure of the milder and uncomplicated forms of paludal fever, it might be presumed to have a most direct and beneficial influence in the cure of dysentery; but so singular are the laws of the paludal poison, that as a general rule, its exhibition in any form or quantity, and in any stage, has proved rather injurious than sanatory.

The favourable and almost specific actions of mercury in many of the secondary actions of the paludal poison make an investigation into the effects of this substance in the cure of dysentery a matter of much interest, especially as it has been extensively used, and in many cases with unquestionable benefit. We regret, however, that much difference of opinion exists as to the circumstances under which it should be administered. Some prescribe it in the acute stage, others restrict its use to the chronic stage, some give it in every stage, while others think it ought to be withdrawn when the tormina is relieved. Some also give it in scruple doses, others more moderately, but push it till the mouth is affected, while others give it only in small doses. In the midst of all this confusion Sir James Macgrigor seems to think this medicine is applicable only to the dysentery of particular countries, and that the dysentery of India and of Europe are different diseases,—dysentery being readily cured by calomel in India, while in the Peninsular war, that medicine was only decidedly useful in dysentery complicated with liver complaints. If given under other circumstances, or in the early stage and before venesection, or in the more advanced stage, particularly when there was hectic, with extensive erosion or ulceration of the intestine, it was invariably found to aggravate the symptoms and to hasten the fatal termination. Ipecacuanha also was formerly much in vogue as a specific in the treatment of dysentery, but it has no pretensions to any such property. It follows that neither bleeding, quina, or calomel, are antidotes to this form of paludal disease, and consequently that there is no exclusive plan of treatment applicable to all cases. Admitting, therefore, the necessity of occasionally employing general and local bleeding, and also calomel, in cases of hepatic complications, we have beyond this only the general principles to guide us of allaying irritation and of controlling, if possible, the diarrhœa; and the best general rules that we possess are those recommended by Sir James Macgrigor to be adopted in the army, and acknowledged by him to be derived from Dr. Somers.

" We commenced," says Sir James Macgrigor, " by copious venesection, and immediately afterwards gave pulv. ipecac. comp. gr. xij. every hour, which was repeated three times, with plenty of barley-water, and profuse sweating was encouraged for six or eight hours. A pill of three grains of calomel and one of opium was administered every second night, and in the intervening day ʒ ij. of sulphate of magnesia dissolved in a quart of light broth. The venesection was to be repeated while the state of strength and pulse permit it, until the stools are free, or nearly so, from blood, following up Dover's powder as a sudorific.

" In cases where the pains were excruciating and attended with tenesmus, the warm bath gave instantaneous relief. This plan being steadily persevered in for a few days the inflammatory diathesis of the intestinal canal, which had excited symptomatic fever throughout the general system, was found to relieve and make way for returning health. In this stage gentle tonics, with light nourishing diet cautiously exhibited, and at first given but in very moderate proportions, were introduced with the happiest effects.

" This disease was not unfrequently cut short by the above plan. If, however, the second stage advanced, and the disease became chronic, a different mode of treatment was pursued, and not unsuccessfully, if the disease had not been of long duration, the intestinal canal not much disorganized, or not complicated with other diseases.

" The first indication in this stage was to relieve the tenesmus and procure easy stools, and with this view ipecacuanha was given, sometimes with calomel, sometimes without it. The neutral salts were given, or oleum ricini, jalap, and various other medicines of the same class. The second indication was, to relieve the number of the stools and to restore tone to the alimentary canal. With this view Dover's powder, pulv. cretæ comp. c. opio—astringents and demulcents, with aromatics, were given, occasionally interspersing laxatives, and obviating particular symptoms as they occurred. Lastly, an infusion of bitters was given to restore tone to the relaxed intestine."

In addition to these remedies Sir James Macgrigor states, that the balsam of copaiba, an infusion of Calumba, hæmatoxylum, kino, and catechu, assisted by opium occasionally, gave much relief, and also the throwing up a variety of enemata, and especially one of a strong solution of superacetas plumbi; while in cases of liver affection he adds, " that friction of the abdomen, with mercurial ointment, gave the least irritation, and at the same time produced less debility."

Such is a statement of the practice pursued in dysentery during the Peninsular war, and on a scale whose magnitude has seldom been surpassed, even in modern times. If, however, we look to the returns, we find it highly probable that not more than two out of three of those attacked ultimately recovered.

In general the dysenteric patient is not admitted into the London hospitals until the disease has passed into the second stage; and in candour it must be allowed there is no class of disease which offers so few chances of recovery. On the Continent the neutral salts and mild purgative medicines are highly spoken of; but it is difficult to understand how these substances, having no specific power over the disease, can be beneficial in a highly ulcerated state of the intestine. Of all the purgatives, however, two ounces of an infusion of ipecacuanha, ʒ j. to lb. j. of boiling water, combined with ♏v. to ♏x. of the tinc. opii, and exhibited every six or eight hours, appear to be best; but the disease, though mitigated, is seldom cured by this means. Mercury also, in whatever dose or form exhibited, has not appeared to take up the disease, or only temporarily to benefit the patient. Vegetable tonics, containing tannin, as kino, hæmotoxylum, or catechu, however prepared or combined, give temporary relief, but are ultimately inefficient. The mineral acids are also seldom useful. Among the mineral astringents the sulphate of copper has been much spoken of; but during the Walcheren expedition, when it was prescribed, from some supposed

virtue, for the cure of intermittent fever, its use was abandoned, on account of the severe diarrhœa which followed its exhibition. Enemata, it may be stated, of whatever description, have almost universally failed even in relieving the patient. Of the remedies less known and less used, the salicine in doses of five grains every four, or every six hours, appears to have the property of curing the milder forms of dysentery, when opiates give but little relief. A few cases have been treated in St. Thomas's Hospital, by balsami Canadensis, gr. v. opii gr. fs. 6tis horis, and the patients so treated have recovered. Dr. Fahnestock, of Pittsburgh, says he treated from 60 to 80 cases of well-marked dysentery, after preliminary purging with calomel or castor oil, with ʒ fs. of spiritus terebinthinæ, and that a very large proportion recovered.—*Med. Gaz.* Feb. 1844.

Dietetic and Preventative Treatment.—The patients should be limited to slops, milk, broths, and at most a fish diet, with a small quantity of wine or brandy. They should carefully avoid cold and wet and night air. In paludal districts they should also be warmly clad.

Of the Poison of Cholera Indica.

The formidable disease to which this poison gives rise is remarkable for its sudden and great eruption in Bengal in 1817, and for its subsequent fearful spread not only over the Peninsula of India, but also over the greater part of the habitable globe. The medical history of India is so imperfect, however, being up to 1774 limited to *two private letters*, written by Dr. Paisly, copies of which were in the hands of most of the older surgeons practising in that country, and to the imperfect works of Bontius, that many persons have doubted whether this peculiar disease is or is not of secondary formation.

There are traces of cholera in India, however, in the most ancient records of the Brahmins. While Mr. Curtis has given an account of a disease which he witnessed in the years 1782-3, both at Madras and Ceylon, so perfectly identical with the cholera Indica of the present day, that there is no question that this disease must have existed occasionally endemically or epidemically in India at former periods. The remarkable fact, however, of its spread from India generally over the globe, and at all seasons of the year, is an entirely new circumstance in its history.

Remote Cause.—The remote cause of this disease is unquestionably a poison, for at no former period has a person in good health in this country been known to become in a few minutes shrivelled up; his whole body to be of an icy coldness; his face and extremities to turn purple, and with or without vomiting of a peculiar fluid like rice-water, to die in a few hours. Neither is it explicable on any other hypothesis than that of a poison that this disease should spread over countries, which, in respect to climate, soil, geological formation, and also to the moral and physical habits of the population, are the most opposite to those where it first originated. Assuming, therefore, that Cholera Indica is produced by the action of a poison, whence does it originate, and how is it generated?

This disease having broken out in the Suderbunds or low country of Bengal, it has been supposed that the poison has a paludal origin. The hypothesis, however, of this poison having a paludal origin seems untenable, for the disease it gives rise to does not follow the ordinary laws of paludal diseases, since Cholera Indica has prevailed in districts far remote from every source of marsh effluvia, spreading to countries of entirely different formation, and raging in seasons when paludal diseases cease to exist. It has been said, however, that this is a peculiar poison, generated in marshy countries, and giving rise to a disease which spreads by contagion. Still it will be shown hereafter, that on no point are the profession more agreed than on the non-contagious nature of Cholera Indica, a disease which continues to prevail in India with great violence, and yet has shown no similar tendency to spread.

If we look to the circumstance of Cholera Indica spreading over all countries and at all seasons of the year, the hypothesis of the poison having a telluric origin is much more accordant with the facts.

Thus, if we suppose it to be generated below the crust of the earth, and consequently beyond the influence of the atmosphere, it is easy to understand why its course is entirely independent of the seasons. Again, if we suppose it to have in any degree a central origin, this circumstance will readily explain why the miasmata, percolating with different facilities the different superincumbent strata, may burst forth at distant and remote places, forming new centres or foci of the disease, although the general course of the stream may be uniform. We can readily understand, also, on this hypothesis, why it may affect particular lines of country, as the banks of rivers, the soil lying more loosely and lightly in their neighbourhood.

Some physicians have imagined, from the streams of the poison having sometimes diverged at right angles to each other, or else proceeding east and west, have trended to the north or south, that the poison, if not the electric or magnetic fluid itself, must be extricated by their agency. This may perhaps be the case, but electricity certainly is not the poison itself, for cholera has been observed to rage in every country under very different electrical condition of the atmosphere, and equally when that element has been in a state of equilibrium, and when it has been most disturbed.

The history and habits of this poison, independently of its action on the human frame, are extremely interesting. It is sporadic and epidemic; and its epidemic progress is as follows:—

The progress of epidemic Cholera Indica, in 1817, is extremely remarkable. It originated in Jessore, and the country around that city in August, 1817, whence it spread east and west. The western branch proceeded towards Calcutta, and after devastating that city, continued its course along the Ganges, till it reached the grand army, about 400 miles from Calcutta, and assembled on the banks of the Sinde, in expectation of a war with the Pindarees. Having reached that point, it penetrated southward into the Peninsula of India, in three great streams. The first proceeded from Calcutta along the Coromandel coast, till it reached Madras, while the other two proceeded from the army as from a centre along its lines of communication, till the one reached Madras, the other Bombay—each town in its path becoming infected, and constituting a new focus, whence the disease spread all around. Having reached the two southern presidencies, it continued its rout southward along the Malabar and Coromandel coasts till it reached Ceylon, and from Ceylon it advanced to its extreme southern limit, the Mauritius.

The cholera does not appear to have spread to the westward of India for about three years; but in July, 1821, or shortly after its re-appearance in Bombay, it broke out at Muscat, Busheer, and Bussorah, the three principal ports of the Persian Gulf. From those points two principal streams arose, or one which, proceeding westward, reached the Syrian shore of the Mediterranean in 1823; while the other advanced northward, till it reached Astrakan in Europe, a port on the Black Sea, and situated at the mouth of the Volga. At both these points, however, the disease now died away.

The progress of cholera eastward was as formidable and as remarkable as that westward. From the coast of Coromandel and Ceylon, the cholera, in 1817, crossed the bay of Bengal, broke out on the opposite coast of Arracan in 1818, reached Penang in 1819, and made its way through the Indian Archipelago, devastating Java and the Spice Islands, till it reached Timor, its extreme south-eastern limit. In the Philippine Islands, the malady was marked by one of those terrific outbreaks of barbarian violence which have more than once added to the terrors of this pestilence. The natives accusing the Chinese and Europeans of magic, and of being the authors of the disease, rose upon them, and 15,000 lives are said to have fallen in the struggle. In its progress to the northward it reached Canton in 1820, and Pekin in the following year, and committed great ravages in the populous empire of China. Having thus reached its extreme eastern limit, the stream passed the northern wall, took a retrograde course, passing through Tartary, desolated many parts of Mongolia, and at length reached Orenberg, a Russian city, situated on the Tartar frontier, about 400 miles north of the Caspian sea, in 1829; but whether this stream subsided altogether, or survived till 1831, is not determined.

The progress of cholera did not attract the attention of Europe till the year 1829, when again it established itself in Astrakan, by the revival of the western branch, and by the arrival of the eastern branch. The disease, however, once more died away in that city; but in 1831 it again returned, breaking out for a third time in Astrakan, on the 20th of July. Its re-appearance in this quarter forms a new epoch in the progress and history of cholera, for it now pursued its course throughout Europe, and, in addition to its cold stage, now came armed with a severe and fatal fever, which had not been observed, or but rarely, in India.

The European stream, as it may now be termed, formed two branches, one of less moment, which spread westward into the Cossack country, while the other extended up the Volga till it reached Moscow, in September, 1831. Moscow now became a new centre of infection, from which three more principal branches streamed over this country; one taking a northerly direction reached Archangel, in May, 1831. Another accompanied the Russian troops in their invasion of Poland, while another passed along the route to St. Petersburg, which capital, notwithstanding numerous cordons of troops, it reached in the month of June, 1831. The disease from these two latter points continued to spread westward till Warsaw became affected, and from this city, as from a new centre, it again progressed westward, following the usual law of adhering to the great roads and banks of rivers, till it reached Berlin and Vienna; the former capital being attacked in August, 1831, and the latter in September of the following year, and from these points it gradually spread nearly over the whole of Germany to the east of the Elbe, till among other places it reached Hamburg; and the next new focus after Hamburg, in spite of a rigorous quarantine, was the port of Sunderland, on our own shores; no continental port westward of the Rhine being yet affected. The first case of cholera observed in England, was on the 26th of October, 1831. From Sunderland it spread north and south, and reached Edinburgh, on the 6th of February, 1832, and London on the 26th of the same month, while it infected Dublin about a month later, or on the 22nd of March, 1832. The cholera having now reached the extreme point of western Europe divided into two branches, one of which pursued its course westward till it reached America, while the other retrograded to the south-east, and invaded France, Italy, and the coast of the Mediterranean generally, as far as Malta. It also attacked Spain, Portugal, and the north-western coast of Africa, when the disease, though still prevalent in India, died away. Such is a slight sketch of the progress of cholera, a course in no degree dissimilar to that observed in the progress of the various influenze which have so frequently and so extensively affected the world.

In pursuing its course, the poison of cholera appears to have been developed in two different manners, probably according to the nature of the country, sometimes forming one or more centres, from which the disease radiated in every direction, and again running in lines of no great breadth, the country on either side being healthy. The instances of its acting eccentrically were many, as at its outbreak at Jessore and Calcutta, and also at London and Paris, the country around those capitals being extensively infected. The examples of its acting in lines or belts are also numerous. In the case of the attack on the camp of the Marquis of Hastings, the space of 50 miles, made the difference between exemption from the disease or death. There were also in India many instances of corps marching in parallel lines at small distances from one another, and keeping up the most free communication, and yet in the one the cholera has been raging, while the other has continued healthy. Also, sometimes after running a long course on one side of the Ganges, it would, as if arrested by some unknown agent, at once stop, and, taking a rapid sweep across, lay all waste on the opposite bank. The same fact was also observed in Canada. In other instances, the disease would sometimes take a complete circle round a village, and leaving it untouched, pass on as it were wholly to depart the district. Then after a lapse of a few weeks or even months, it would suddenly return, and scarce re-appearing in the parts which had undergone its previous ravages, would nearly depopulate the spot which had so lately congratulated itself on its escape. Again, in its progress along the Ganges it passed over many large towns and cities, as Banda, Allahabad, and Benares, places which lay in the direct route from Calcutta to the camp of the Marquis of Hastings, and then, like a receding wave, only the more heavily fell on them the following year.

In some fortunate instances the country over which the cholera has thus passed has escaped altogether. Hanover, for example, with the exception of Lunenburg, escaped, as did also the principal towns in Saxony, as Leipsic and Dresden. Weimar, Gotha, Anhalt, Hessia, Brunswick, Mecklenburg, and Bavaria, likewise escaped the disease, as did many countries to the south

of Vienna, as Carinthia, Stiermark, and the Tyrol, though surrounded by infected districts.

We have seen that the great streams of cholera on the whole steadily advanced in their course, but they did not proceed at an uniform pace,—the rate of progression varying in different countries. In the year 1817, the cholera had overrun in India, in three months, a space westward of not less than 400 miles, while to the south it had penetrated no farther than Ganjam, only 88 miles from Calcutta, in six months. In the next six months, however, it had extended in a southerly direction over more than four-fifths of the Peninsula. It reached Pekin about the same time it attacked Muscat, the former being twice the distance of the latter. In Europe its progress was equally capricious. It travelled from the Caspian to Vologda and Pskou, within 100 miles of the Baltic, at a rate which would have infected all Europe in three months, while it did not reach Riga, only 180 miles distant from the latter town, till eight months after. Its rate, however, appears to have been most retarded in its retrograde movement; for it took six years after London was infected to reach Rome, and about seven years to travel from Pekin to Astrakan. In a word, it took only one year to span the base of the Peninsula of India, while it occupied 20 years' to compass the globe.

In Europe, and also in India, cholera has prevailed in all seasons, at all periods of the year, and under every degree of heat or cold, of dryness or moisture. It is remarkable, however, that there is in India a period termed the cholera season. In Bengal, for instance, this season usually begins with the heats of March and April, when the cases are few; in May, the disease is generally at its height, and is more or less epidemic, while in June and July it begins to decline, and on the setting in of the cold weather, in October, it so far disappears, that the cholera season is said to be terminated for that year.

Although the cholera has raged in countries of every altitude, has devastated the high table lands of Nepaul, and even attacked the medical depôt at Landorn, situated 8000 feet above the level of the sea, a height which in Europe is almost the region of perpetual snow, yet in general it follows a law common to many other epidemics, or a marked disposition to affect low marshy situations and the banks of rivers, while healthier and more elevated tracts have been more slowly attacked, and more quickly freed from it.

The last remarkable circumstance we shall notice relating to this poison, and which is perfectly inexplicable, and not known to be common to any other morbid poison, is, that in Europe and America the disease has been accompanied by a series of new and terrible symptoms, unknown, or nearly so, in India, a second or febrile stage being added, and which most commonly destroyed the patient after he had successfully struggled through the cold stage, as if the poisons of cholera and of typhus fever had conjoined, forming a new compound which had the deleterious properties of both diseases.

Predisposing Causes.—The deaths from cholera in Paris were estimated at 18,402, and it was remarked that all *ages*, including new-born children, were liable to this disease, but that the mortality was least from 6 years to 20, greater from 30 to 40, and greatest of all in old age. The influence of *sex* in predisposing to cholera can hardly be said to be determined; for in Calcutta, of the native inhabitants attacked with cholera, the males were to the females as four to one, while in Bombay the proportion was as 7 to 25. In Canada the soldiers' wives were observed to suffer nearly in an equal proportion with their husbands; and this was the case among the civil inhabitants of Gibraltar.

In all countries the *lower classes* have always suffered in a much greater proportion than the upper classes. In Calcutta the disease ran a wide career of destruction in the native town, while the "City of Palaces," inhabited by the English, was much less affected in proportion to their numbers, and the same disproportion has been observed, in Bombay. In general also it has been observed among the native inhabitants of India, that the Bramin and Banian merchant suffered less than the Ryot or farmer, while the poor outcast Pariah suffered the most of all. In every town in Europe also it has been observed that the lower classes, and especially those resident on the banks of rivers, have suffered infinitely more than the upper classes.

In military life it has been supposed that the Sepoy suffered more than the European soldier living in India. This perhaps is true in some instances; but the returns of the Madras army show this not to have been the fact in that Presidency; for the European soldiers attacked appear to have been as one to three, while of the Sepoy force it was only one in four and a half. In the Indian army also it appears to have been universally observed, that the officer suffered in a less proportion than the soldier, the cavalry than the infantry, and the infantry less than the hard-labouring ill-fed camp-follower. The troops on march likewise universally suffered more than the troops in quarters.

The effects of a poor diet will perhaps be better understood, by stating that the European suffers less than the Mohammedan, and the Mohammedan, who is better fed and better clothed than the Hindoo, except during their rigid fasts, when the Mohammedans suffered in a much larger ratio.

Susceptibility exhausted.—The actual number of persons attacked out of any given population appears to have varied very greatly. Mr. Scott has stated, that in the marching corps it has varied from 17 to 330 per corps of about 1000 men; and in no instance, even in all the wretchedness of the Indian towns, has the community suffered to the whole extent of the population. In Europe, Moreau de Ionnès has given the following estimate as an approximation to the probable numbers attacked in this part of the world: In France, 1 in 300; Russia, 1 in 20; Austria, 1 in 30; Poland, 1 in 32; Prussia, 1 in 100; Belgium 1 in 120; Great Britain and Ireland, 1 in 131; Holland, 1 in 144; Germany, 1 in 700. The circumstance of one attack by no means armed the constitution against a second in the same or any subsequent year; still a repetition of the disease in the same party in the same year was rare.

Co-exists.—The poison of cholera is capable of co-existing with many other poisons. Several patients were attacked while labouring under syphilis. One man labouring under small-pox was attacked, when the pustules immediately shrivelled and dried up. Typhus fever and cholera ran constantly into each other, and sometimes cholera terminated in intermittent. No disease has yet been remarked as giving an exemption to cholera.

Modes of Absorption.—We possess no data to enable us to determine by what tissue the poison is absorbed; but it is probably the mucous tissue, and infects the blood; for that fluid is found greatly altered, certainly

Elementary Principles of Medicine.

in its constituent parts, if not in its chemical qualities.

Period of Latency.—The period of latency probably varies considerably, and in some instances it is extremely short. The King's 41st regiment arrived in two divisions from England at Madras, and within three days of their arrival the cholera was raging among them. The minimum of time is undetermined; but troops leaving their barracks perfectly healthy have been attacked after a few hours' march. Again, a vessel sailing from an Indian port has reached the line before the disease has broken out,—a voyage seldom performed in less than a fortnight.

Pathology.—The theory of this disease is, that a poison has been absorbed and infects the blood, and that after a given period it produces disordered action of the muscles or parts supplied by the spinal cord, also of the lungs or parts supplied by the eighth pair, and likewise of the alimentary canal generally, or parts supplied by the great sympathetic. Again, if the disease passes into the second stage, it produces in addition fever and inflammation of the membranes of the brain.

The depressing influence of this poison is so great that life has frequently been destroyed in a few moments, and not unfrequently in two or three hours. It will be plain, then, that a poison so powerful, so suddenly overwhelming all Nature's efforts at resistance, does not allow time in many cases for any secondary or specific actions to be set up. In those patients, therefore, who have fallen in the first stage, or within 48 hours of the attack, rarely has there been found any alteration of structure in any organ or tissue, unless the disease has been preceded by long-continued diarrhœa, in which case the follicular structure of the intestinal canal has been found to be enlarged, and the intestine filled more or less with a turbid, inodorous, semi-diaphanous fluid, usually compared to a thin starch or rice-water, the remains of that immense secretion which has taken place during life, and which, being tested, has been found sometimes acid and sometimes alkaline. A layer of greyish mucus has also been found coating the whole of the mucous membrane of the alimentary canal, but without a trace of bile, although the gall-bladder is usually filled with that fluid. If the first stage has been prolonged the mucous membrane of the alimentary canal is of a livid colour, and in some instances has presented a mammillated appearance, probably caused by an enlargement of the follicles; for, according to Dr. Budd, by drawing the coats of the stomach between the finger and the thumb, and using some pressure, a white opaque fluid is squeezed out, and the mammillated appearance effaced.

The liver, the spleen, and the kidneys, have in general been found gorged with blood, and this engorgement extends even to the bones, which, Louis says, appear as if the animal had been fed on madder. The bladder is contracted and empty. The membranes of the brain and cord are in general congested, and the substance of the brain dotted with more puncta cruenta than usual.

Such are the appearances which the body has presented, when the patient has fallen in the first, or asphyxiated, or pulseless stage; and the phenomena are said to differ in no respect from those observed in persons who have died in the first stage of intermittent fever, when the blood, driven from the periphery, accumulates in the centrical parts of the body. The enlargement of the follicles is supposed to be peculiar to those cases in which diarrhœa, or other disorder of the alimentary canal, had for some time preceded the fatal attack.

When the patient has survived until re-action has taken place, and the second or febrile stage has been formed, the body no longer presents that shrunk, worn, and livid appearance it did on death taking place in the first stage; but on the contrary, rather the fulness and plumpness of the fever patient. The injection of all the large organs has also disappeared, the blood being recalled to the surface of the body. The alimentary canal is no longer distended with the turbid secretion peculiar to cholera, but contains a thin yellowish *purée* of fæcal matter, having the usual odour. The mucous membrane of the alimentary canal has now, however, been found more or less diffusely inflamed, sometimes in all its divisions, but more especially of the pyloric portion of the stomach, and also of the duodenum. The Plaques du Peyer as well as Brunner's glands, though occasionally found enlarged, were seldom found ulcerated; but when that was the case the corresponding mesenteric glands were also enlarged, being sometimes pale or purple, and when cut into gave issue to a dark liquid blood.

The lungs have often been seen congested, and in the first stage of pneumonia, while the brain has presented the ordinary appearances of fever, or more puncta cruenta than usual, the membranes being often congested or inflamed, with the usual serous effusion into the arachnoid cavity.

Symptoms.—Cholera Indica has no varieties but many degrees, and hence many pathologists have divided it into Cholera Indica mitior, and into Cholera Indica gravior. The French have termed the slighter forms of the disease Cholerine.

The Cholera Indica is divided into two stages, or into the cold, pulseless, or asphyxiated stage, and into the hot or febrile stage. This latter stage, however, is not essential to the disease, and has been observed in India in a small proportion of the cases only. In Europe, however, the febrile paroxysm has followed in the majority of instances. The duration of the cold stage varies from a few minutes to 12, 24, 48, or even more hours, while the hot stage lasts from four to eight or more days, making the total duration to vary from a few minutes or a few hours to two, three, or even four weeks.

The attack of this fatal epidemic is most commonly sudden, the patient at the time of his sickness being apparently in his best health; yet not unfrequently slight diarrhœa or other general indisposition has preceded it. In India in some cases the premonitory symptoms are vertigo, noise in the ears—the latter sometimes so loud as to have been compared to the humming of a thousand swarms of bees, to the beating of all the drums in the camp, or to the roaring of the surf on the Coromandel coast.

The disease being formed, the suddenness with which the poison sometimes extinguishes life is extremely remarkable. When the cholera reached Muscat, instances are given in which only ten minutes elapsed from the first seizure before life was extinct. In one instance a Jew merchant was closing a bargain, when he suddenly vomited twice, fell down, and expired. Many natives at Hoobly were attacked while walking in the open air, and having retched, complained of vertigo,

blindness, or deafness, fell down, and expired in a few minutes. At Punderpore also the disease is said to have been fatal in an equally short time, so much so that 350 persons are reported to have died in the streets, "tumbling over each other lifeless," or, according to another authority, "as if knocked down dead by lightning." Instances of death taking place in two, three, four, or more hours are extremely common. The more usual course of the disease, when limited to the cold stage, is as follows :—

After the patient has been troubled for a few days with diarrhœa, but more commonly while he is yet in perfect health, and has retired to rest, and has slept soundly till the middle of the night, or far onwards till morning, he is suddenly seized with a most unaccountable sickness and vomiting, together with a most profuse discharge from the bowels. These evacuations are attended with most severe pains down the thighs, and more especially by an indescribable and subduing sense of exhaustion, the patient often fainting in the water-closet. In an instant not only are the physical powers of the body exhausted, but its temperature sinks rapidly below the natural standard, and an icy coldness benumbs it; while the skin is sometimes rendered so insensible, has so lost its vitality, as to resist even the action of boiling water or other powerful chemical agent. The breath also, as it issues from the mouth, has a glacial feel. Still, notwithstanding this great loss of temperature, the patient complains of being oppressed with heat, is incessantly throwing off the bed-clothes, and cold water is grateful to him, copiously and eagerly drank, yet affording no relief to his insatiable thirst.

The extreme coldness of the first stage is further accompanied by a blue, livid, or purple discoloration of the hands and feet, extending not only a considerable way up the arms and legs, but sometimes over a great part of the body. These parts often also become, in a few minutes after the seizure, not merely shrunk, but singularly wrinkled, like the hands of a washerwoman after a day's hard labour. These frightful symptoms are rendered still more distressing by the shrieks and groans of the poor sufferer, often tortured by horrible spasms, which affect the fingers, the toes, the arms, or the legs,—spasms which clench the jaw, fix the walls of the abdomen in contact with the spine, or draw the trunk into singularly contorted forms. The patient thinks he obtains some relief from friction, and his cries are incessant to his attendants to "rub hard."

As the disease proceeds the countenance assumes a character peculiar to this great struggle, or the facies choleritica, the eye being deeply sunk, red, and injected; while the aqueous humour transuding its coats leaves the cornea flat and depressed as in the dead body; a broad and livid band also encircles the lower portion of the orbit; every feature, moreover, is sharp and pinched, as after a long disease; the complexion thick and muddy; the lips and tongue purple; and all these great changes have been known to take place in a few minutes.

In addition to this sad state, the vomiting is constant, the purging most incessant, and the pulse, though generally natural, sometimes rapid, yet in some cases is not to be felt, even from the first moment of the attack, either in the large superficial arteries or at the wrist. The voice also is strangely altered, its firm and manly tone has changed to a low, feeble, unnatural, and almost sepulchral sound. The urinary secretion is likewise entirely suppressed, while no bile flows into the intestines. The only organ which seems to preserve its powers is the brain; and the patient often to the last moment of his life retains the power of thinking and of expressing his thoughts distinctly, sometimes full of hope, while at others he seems indifferent to the fate which too often inevitably awaits him.

On the accession of the spasms, of the vomiting, and of the purging, the disorder is fully developed, and the crisis is at hand which in a few hours must decide the fate of the patient. The termination may be favourable or unfavourable; if unfavourable he may die with all the symptoms narrated strongly marked, or should it be favourable they may abate, and a happier prognosis be formed. Unfortunately, however, it too often happens that, although the stomach retains what is taken, and the purging appears checked, and the patient falls into a dose, yet the weakness, the entire cessation of the pulse, the coldness and lividity of the surface, and the ghastly expression of the countenance, show that a few hours must close the scene. This melancholy result occurred to Gendrin in 17 out of 20 cases, and often with so little struggle that death was only marked by the phenomenon of cadaveric contraction.

But, strange to say, death does not always terminate the singular phenomenon of the cold stage of this extraordinary disease; for in many instances after the functions of the brain have ceased, and life is apparently departed, the hand has been seen to move, the toes to bend, the jaw to become clenched, the leg to rotate, and the muscles of the thigh to quiver; and in India instances have been seen of the dead body having been drawn into an upright sitting posture, and even to make a round turn on the table on which it has been laid out. These phenomena often last for some hours, and show that the cord continues to supply a nervous power long after the brain is dead.

If the patient should happily survive the cold stage, the disease may terminate by a rapid recovery, or else may pass into the second or febrile stage. The former is the more usual course in India, the latter in Europe. The first symptom of returning health is the patient falling into a sleep of unusual soundness, during which the respiration becomes light and easy, the pulse freer, while a gentle warm perspiration bedews the whole body. This grateful pause in the disease appears to be the result of the returning powers of life, almost uninfluenced by medicine, for it often occurs where none has been given. After this balmy slumber the patient awakes refreshed, and often recovers so rapidly, that in the natives of India it almost resembles a restoration after syncope. In all the presidencies, indeed, and especially in Bengal, the recovery of the European has in general been followed by a stage of re-action, usually slight, but in some cases assuming the form of the bilious remittent or country fever, and which has occasionally terminated fatally.

In Europe, restoration after the cold stage and without febrile re-action, is by no means so frequent or so rapid as in India. Sometimes the re-action is trifling, and sleep may indeed have ensued, fæcal evacuations containing bile may have passed, the urine may again have flowed, the purging, vomiting, and spasms may have subsided, the pulse may have risen, the blueness may have disappeared, and the temperature of the body may have increased, yet in many instances this amelio-

ration of the symptoms was only temporary, and the patients relapsed and died.

In 13 cases out of 20, however, the re-action was more considerable, and the patient, in a few hours after the subsidence of the cold stage, laboured under a severe form of fever in no degree dissimilar to, and not less fatal than, typhus. For the first few hours after the febrile re-action the tongue was white, but quickly became brown and dry, while a black sordes incrusted the teeth and lips. The eye now was deeply injected and red, the cheek pale or flushed, the pulse rapid, and the temperature of the body a little above or below the natural standard; and the patient, either delirious or comatose, lay in a state resembling the last stage of the severest continued fever of this country. This struggle usually lasted from four to eight days, when the symptoms either gradually yielded or death ensued. In a few mild cases the fever assumed an intermittent type, or sometimes a quotidian, sometimes a tertian form; all these cases usually recovered. Such is a general outline of the symptoms of this formidable disease.

The blood in cholera varies according to the stage, and that taken in the cold stage is usually of an unnaturally dark colour and thick consistency, so that it flows with difficulty from the veins, and very imperfectly separates into clot and serum. Blood also taken from the temporal artery has been found equally black and thick. Chemical analysis has shown this singular state of the blood to be partly owing to a deficiency in the quantity of serum in proportion to the clot, to a deficiency of fibrine, and to some diminution in the quantity of the usual salts. In those cases in which the urine is suppressed, urea has been detected both in the blood and in the bile. After the fever is formed the quantity of serum increases, till at length it is much more abundant in the blood than natural; and it is singular this takes place, notwithstanding the secretion of urine is re-established.

Diagnosis. — The phenomena of the first stage of Cholera Indica are so unlike those of any other disease that they cannot be mistaken. The second or febrile stage is similar to many of the forms of typhus fever, and is not to be distinguished from them, except by the previous history. The Cholera Indica differs from the cholera morbus of Sydenham in the lividity of the extremities, the suppression of urine, the nature of the evacuations, in the loss of the pulse, and in the greater amount of collapse.

The Cholera Indica, as seen in India, differs also from that of Europe, according to Drs. Barry and Russell, in the evacuations of the former being more profuse and ungovernable, and again from the patient being much more frequently convalescent, without passing through the febrile stage.

Prognosis.—The mortality from cholera in all countries is very great. Taking the whole number attacked, it is said that the number of deaths in Astrakan were as one to three; in that of Mishni Novogorod as one to two; in Moscow and Casan as three to five; and in Penza, in the country of the Don Cossacks, as two to three. In the summer of 1831 the mortality at Riga, St. Petersburg, Mittau, Limburg, and Brody, according to the Berlin Gazette, was about one-half, while at Dantzig, Elbing, and Posen, it was about two-thirds of the whole number attacked. The period of the season, however, greatly influenced the mortality; for, on the first onset, nine-tenths of all those attacked perished, then seven-eighths; and the proportion of deaths forms a gradually decreasing series of five-sixths, three-fourths, one-half, one-third, till towards the close of the season a large proportion of those attacked recovered. The uniformity of this law in every country affected with cholera, whether Europe, America, India, or China, is extremely remarkable.

The chances of recovery are much diminished in young children and in the aged; the age of greatest number of recoveries being from 15 to 20. The feeble in constitution, the sick and the convalescent, were in all cases the surest victims of cholera. But whatever the age of the party, Gendrin states he lost every case which became pulseless.

Treatment.—There are few diseases for the cure of which so many different remedies and modes of treatment have been employed as in cholera, and unfortunately without our discovering the antidote to this poison. In Moscow, it is said 20 different modes of treatment were practised at different hospitals, and that the proportionate number of deaths was the same in all. In the same city also, it is supposed that the mortality was not greater among those destitute of medical aid than among those who had every care and attention shown them. It may be fairly inferred, therefore, that in the severer forms of the disease, the action of this poison is so potent, as to render the constitution insensible to the influence of our most powerful remedial agents. When, however, the disease is mild, or on the decline, much may be done by obviating symptoms to promote the recovery of the patient.

The heroic remedies that have been employed in cholera, are bleeding, calomel, and opium, either separately or conjointly. With respect to bleeding, it may be stated, that in every country the patients bore bleeding badly in any stage, and that the practice in Europe was at length limited to a few leeches occasionally to the head. As to calomel that medicine was used to the greater part of an ounce in the 24 hours, but with so little success as an antidote, that many patients have been seized and died under the full influence of mercury. On the appearance of cholera in Europe, opium was administered in the doses recommended by the Indian practitioners, or to the greater part even of an ounce of laudanum, but it was soon seen that, in the cold stage, it was inefficient in controlling the vomiting or purging; that it did not allay the spasms, and, moreover, hardly produced any narcotic effect. The action of the accumulated doses of opium, however, though suspended during the cold stage, was often fully developed in the hot stage, and occasioned so much affection of the head, that most practitioners either abandoned its use, or else limited it to a mere fractional dose of that exhibited in India, or to ♏iij. to ♏ xij. of tinct. of opii, or to gr. ſs. to gr. j. 6^{tis} vel 4^{tis} of solid opium.

Another heroic plan, peculiar perhaps to this country, and which was practised when the inefficiency of medicines was generally admitted, was an injection of a solution of ʒ ſs. of muriate of soda, and of ℈ iv. of sesquicarbonate of soda, in ten pints of water, of a temperature varying from 105° to 120° Fahrenheit, into the veins of the suffering patient. This solution was injected slowly, half an hour being spent in the gradual introduction of the 10 pints, and the immediate effects of this treatment were very striking. After the introduction of a few ounces, the pulse which had ceased to be felt at the wrist became perceptible, and the heat of

the body returned. By the time three or four pints had been injected, the pulse was good, the cramps had ceased, the body that could not be heated had become warm, and instead of a cold exudation on the surface, there was a general moisture ; the voice, before hoarse and almost extinct, was now natural ; the hollowness of the eye, the shrunken state of the features, the leaden hue of the face and body had disappeared, the expression had become animated, the mind cheerful, the restlessness and uneasy feelings had vanished, the vertigo and noises of the ear, the sense of oppression at the precordia had given way to comfortable feelings ; the thirst, however urgent before the operation, was assuaged, and the secretion of urine restored, though by no means constantly so. But these promising appearances were not lasting ; the vomiting continued, the evacuations became even more profuse, and the patient soon relapsed into his former state, from which he might again be roused by a repetition of the injection ; but the amendment was transient, and the fatal period not long deferred. Of 125 patients thus treated at Drummond Street Hospital, under the direction of Dr. Mackintosh, only 25 recovered,—a lamentably small proportion.

The great want of success that has attended these heroic methods, has caused every substance at any time known in the pharmacopœia to be tried as an antidote. Every metal, from arsenic to platina, was exhibited ; also every vegetable and mineral acid ; the various alkalies, and most of the neutral salts ; phosphorus ; strychnine and quina ; hæmatoxylum, kino, and every known vegetable astringent ; hydrocyanic acid ; the entire class of narcotics ; the large class of essential oils, balsams, turpentines and spices, and most tonic medicines ; and when these failed, the patient has been made to respire oxygen or nitrous oxyde gas ; and with a view of imparting new powers to the sinking frame, transfusion of blood has not unfrequently been performed ; but all these means have been equally unsuccessful.

The failure of all these powerful means at length caused most practitioners to confine themselves to checking the diarrhœa which so frequently precedes cholera, and lays the foundation of the future attack, and subsequently to obviating symptoms. For this purpose moderate doses of opium or morphine, either alone or combined with stimulants, as the confectio opiata, or the pulvis cretæ compositus cum opio, were often sufficient. In more obstinate cases some vegetable astringent was added, as the tinct. of kino, or the decoctum hæmatoxyli, and these remedies frequently prevented the attack altogether. If, however, the disease proceeded, and the cold stage of cholera formed, the same remedies were prescribed, moderate in quantity, and often out of an effervescing draught. Heat was also now applied, and the patient wrapped up in warm blankets and hot bottles, or bags of heated sand placed around his cold and benumbed body. The warm bath was at first tried, but discontinued from the uncontrollable nature of the vomiting and purging, and the oppressive heat it produced to the patient's feelings. Mr. Dalton's vapour-bath was next used, but without benefit, and to the disappointment of the hopes which had been entertained of it. Other methods of restoring warmth were also had recourse to, as frictions with the hand, or by flesh-brush, or rubbing the body with some stimulant embrocation, compounded of garlic, capsicum, camphor, cantharides, or other powerful irritant. Mustard poultices also were often applied to the feet and abdomen, blisters with or without an addition of oil of turpentine, the part having been previously rubbed with hot sand ; and in more urgent cases, the mineral acids, and even boiling water were employed for the purpose of producing instant vesication. And again, other practitioners tried to stimulate the waning powers of life by galvanism, acupunctuation of the heart, issues, setons, moxas, actual cautery along the spine, and lastly, by small pieces of linen dipped in alcohol, and distributed over the body, and then set fire to.

In a few instances these efforts were rewarded with success, re-action and the second or febrile stage formed. It was at this period that some physicians thought that calomel should be exhibited in moderate doses, for the purpose of producing a flow of bile into the intestines, and of emulging the gall-bladder and ducts, as well as of restoring the other suppressed secretions. The indications, however, more generally followed, were to treat the case as we should a similar state of typhus, namely, to moderate the affections of the bowels by mild opiates, by enemata, and by sinapisms to the abdomen ; also to relieve the head by leeches and cold lotions, and subsequently, as the tongue became brown, to support the patient with wine, sago, strong broths, and a generally cordial treatment.

Dietetic and Preventative Treatment.—It is plain, from the severe derangement of the alimentary canal, that mucilaginous drinks and light broths, either alone or combined with brandy, will be proper in the first stage of the disease. In general these drinks were given warm, but the patient had often a craving for iced cold drinks, and no inconvenience has resulted even when he has drank freely of them. In the second stage, the diet was a milk diet, with strong broths, but wine was seldom beneficial, or only so in very small quantities.

The preventative rules were to avoid everything that could occasion indigestion ; for in every country there were numerous instances of cholera having immediately followed eating ascescent fruits, or uncooked vegetables. In Calcutta, eating shell or the table fish caught in the Ganges has often led to the same consequences. Acts of intemperance or debauchery were equally fatal. In India it is an axiom to avoid the great heats of the day, and also the damps of the night air. Again, on a march to avoid, as far as possible, encamping in infected districts, or on the banks of rivers. The greater question, however, which a consideration of the preventive treatment involves, is, whether cholera is or is not contagious, and consequently whether any precaution is necessary in our intercourse with the sick.

The great argument, which is urged in favour of the contagious nature of cholera, is that, originating in India, it has spread east and west, extending along the high roads and banks of rivers, from city to city ; and also that in a very few instances the medical and other attendants have suffered in a larger proportion than the community generally, and consequently it is inferred that the disease is propagated by miasmata generated by the patient's person. On the contrary, it is contended that cholera is not contagious, because that disease still rages in India with its fullest force, and yet does not spread, although the communications with that country are far more frequent and rapid than at any former period. Again, that the progress of cholera has been in no degree dissimilar to that of other epidemic diseases not generally considered contagious.

Elementary Principles of Medicine.

And lastly, that the instances of medical officers and other attendants on the sick not suffering in a greater proportion than the rest of the population, are numerous, and far outweigh the few cases which can be adduced to the contrary. It will only be necessary to add a few examples of the immunity of the attendants generally on the sick to place this argument in its proper light.

Mr. Jameson states, that in Bengal the general voice of the inhabitants at large is uniform against the disease being contagious or conveyed from person to person. He adds also, of 250 officers, comprising the medical staff in Bengal, all but one are non-contagionists; and that out of the whole list only three of these gentlemen were known to have been attacked with cholera during the three years it most severely raged, or from 1817 to 1820. On the Bombay side also the reports equally corroborate the general exemption of the medical officers and attendants on the sick. Thus Dr. Taylor affirms, of 44 assistants employed under him only three were seized with cholera.

It has been thought that the disease, though not contagious in India, where the Hindoo lives "sub dio," and is, from his religion, cleanly to excess, might still be contagious in Europe, where it acquired a new property of a febrile stage, and where the habits of the people are less cleanly, and indeed entirely different, from those of the natives of India. But the evidence of the non-contagious nature of cholera is as positive in Europe as in India.

Drs. Russell and Barry, in their communications with the British government, state, that 25 physicians at St. Petersburg held a consultation whether the cholera was or was not contagious, when 21 declared it to be non-contagious. Chambert, of the Warsaw commission, states, that of 100 physicians, English and German, about the sick in Warsaw, none suffered from cholera.

The number of practitioners in Paris is estimated at 1800, yet not more than 25 to 30 laboured under this disease, and of these not more than 15 or 16 died. Again, the wards of the Hôtel Dieu, assigned for the reception of the cholera patients, were filled, still no case was proved to have occurred from infection among the 12 physicians, the 100 pupils, or the many hundreds of medical men that came from all quarters to see the disease. The nuns and the nurses escaped also with an inconsiderable mortality. In England, in Gibraltar, and in the Canadas, the experience of the profession was to the same effect; and if we add to this, that many hundred bodies were dissected, that some physicians inoculated themselves with the blood drawn from the cholera patient, and also tasted the matter vomited; have lain also in the wards of the cholera hospitals for nights together, rubbed, been in the closest contact with the sick, and yet have not fallen in any greater proportion than the population generally—the conclusion seems forced that cholera is an *epidemic*, and not a contagious disease.

Of the Poison of Influenza.

Influenza is a catarrhal affection, generally accompanied by fever and cough, sometimes with sore throat, and often going off with an affection of the bowels.

This class of affections was known to Hippocrates, and is mentioned in his aphorisms, his prognostics, as well as in other parts of his works; but this physician, as well as the ancients generally, considered it as having merely a local origin, as being endemic in different towns and districts of Greece or Italy, and as being caused by the vicissitudes of the weather. Towards the close of the XIIth and XIIIth centuries, however, it was observed that catarrh was not only endemic in particular districts, but that it occasionally spread over large portions of country, while still later, or in the year 1557, it was found to prevail epidemically, not only over the whole of Europe, but even over the whole of the northern hemisphere, beginning in Asia and proceeding westward till it terminated in America. In the XVIIIth century a new law of its progression was observed, as that having advanced westward till it reached the Elbe, it passed over the intermediate countries and reached England, where the stream broke into two branches: the one crossing the Atlantic to America, while the other retrograded south-east through France, Spain, and Italy, till it was lost in the Mediterranean,—a course similar to that described by cholera.

Remote Cause.—The influenza has occasionally originated as far eastward as India, but more commonly it has broken out in the north of Europe, as Moscow, Warsaw, or Dresden; and consequently there must be many primary foci or centres of this poison. It seems probable that, like the poison of Cholera Indica, its spread may be limited to a small number of these primary foci; for we find, in every volume of the Calcutta Transactions, accounts of some catarrhal fever spreading for a season along the banks of some principal river, and then subsiding; so that it is evidently only occasionally and at long intervals *erratic*, as in 1729, 1743, 1775, 1782, 1831, 1833, and 1837. The influenza, therefore, is both endemic and epidemic; and, in the latter case, we find it, at least in Europe, spreading from east to west, prevailing in the depths of winter as well as the heights of summer, lasting nearly the same space of time in the different towns and cities it attacks, or from four to six weeks, affecting contiguous places in different degrees and at different times—circumstances so remarkable, that it seems impossible to explain them, except by supposing the existence of a poison generated beneath the crust of the earth, and beyond the reach of atmospheric influences: an hypothesis which assimilates its origin to that of Cholera Indica.

On looking to the habits of this poison it is probable that its actions are not limited to men; for in most years, when influenza has been epidemic, a similar disease has been epizootic.

Predisposing Causes.—The attack of influenza is for the most part so universal that large portions of the population of every country in which it has prevailed, without respect to age, sex, or condition, have been commonly infected. In general, however, women, from being less exposed to the weather, have suffered in a smaller proportion than men, and children less than either. In all of these epidemics the aged, however, suffer greatly. The calculation of Dr. Heberden for the year 1837 is—of persons between 30 and 40, 412 died; of persons between 50 and 60, 500 died; while of persons between 70 and 80, 563 died, an enormously increasing ratio. In the same year also the mortality at Salpetrière, where the inhabitants are chiefly the aged poor, was increased one-third over former seasons.

It has been remarked, in the several influenze, that the low parts of the towns have been more generally and more severely affected than the higher and more healthy districts.

Susceptibility exhausted.—Few persons suffer more than one attack of influenza in the same season, although many relapse; but one attack of this poison in no degree protects the constitution from a second in another season.

Co-exists.—The influenza has often co-existed with measles, scarlatina, syphilis, and probably with every other disease produced by any other morbid poison.

Modes of Absorption.—This poison probably follows the laws of most other morbid poisons, and is absorbed by the mucous tissues, and infects the blood. The argument for the latter assumption is, that influenza has been greatly fatal to pregnant women. Majendie, speaking of this law, says, "I *believe* it, although I dare not affirm it."

Period of Latency.—It is extremely difficult to determine the period of latency of an epidemic disease. If, however, we suppose the poison to have a land origin, there are instances of persons being seized within 24 hours after their landing from a voyage from a foreign country. In other cases, however, the period has appeared to vary from 10 to 20 days.

Pathology.—The theory of this disease is, that a poison is absorbed and infects the blood, when, after a given period of latency, it produces disordered functions of the great nervous centres, causing great general depression, together with slight or severe remittent fever. The specific actions of this poison are on the mucous membrane of the eyes, of the nose, and of the bronchi, causing common catarrh. In a smaller number of cases, on the mucous membrane of the fauces, causing sore throat, and in a still smaller ratio on the substance of the lungs and on the pleura, causing inflammation of those organs. In most instances the disorder terminates in diarrhœa by an ultimate action of the poison on the mucous membrane of the intestinal canal. These different pathological phenomena vary in frequency and complexity in different seasons.

In most cases, when the poison is of sufficient intensity to produce fever, the type is remittent, with exacerbations in the evening. Its usual duration is two, three, or four days, when it terminates in an abundant sweat, and which not unfrequently leaves great debility behind it.

At the same time, however, with the fever, or else preceding or succeeding it, the patient has in general been seized with a slight inflammation of the ocular and nasal membranes, followed by coryza, or the serous discharge of a common cold or catarrh; and this inflammation generally affects the larynx and trachea, while either are attacked by sore throat or pneumonia.

The proportionate numbers of those attacked with pneumonia cannot perhaps be determined, for the hospitals admit only the worst cases. Thus, out of 125 male patients suffering from influenza, and admitted into the Hôtel Dieu, between the 15th January and 1st March 1837, 33 laboured under pneumonia—an enormous proportion. The women appeared to suffer in a less proportion from this inflammation, for out of 58 female patients 7 only had pneumonia.

The pneumonia occupied most commonly the middle and lower lobes, and only rarely the summits of the lungs: out of 40 cases observed by M. Landan the inflammation occupied 21 times both lungs, 11 times the right lung, and 8 times the left. The forms of pneumonia are principally serous inflammation and red hepatization, the latter occasionally interspersed with a few points of pus. Majendie, in demonstrating the nature of "la grippe" to his pupils was enabled to show them specimens of both those states.

The bronchial membrane, when examined, was in general found red, and covered with the secretions usual in bronchitis. The appearance of the sore throat was that of a broad dusky-red band extending over the fauces, uvula, and tonsils. The uvula was elongated; but the tonsils were rarely swollen, and still less frequently ulcerated.

Symptoms.—The symptoms of influenza often form themselves into different groups, giving rise to many varieties. Thus the catarrh often existed without the fever, and, in a smaller number of cases, the fever without the catarrh. The angina was frequently the most prominent symptom, while in other instances the bronchial affection alone harassed the patient.

Whichever of the forms prevailed the disease usually began with shivering, general soreness, headache, and pains in the limbs; and these symptoms were frequently accompanied by fever, slightly increased towards evening. The patients were usually seen about the third or fourth day, and they now complained of cough, tightness of the chest, of pain in the epigastrium, and also of dyspnœa. The face was likewise flushed, the alæ of the nose red, the lip vesiculated, the eyes streaming with coryza, and the voice altered as in a common cold. The tongue was moist, or coated with a yellow mucus, the skin open and without morbid heat, the pulse little augmented in frequency. But notwithstanding each of the particular symptoms were mild, there was a languor, debility, and dejection of spirits far beyond what might have been expected, and almost exceeding that of common fever, and which was in many instances long in subsiding.

In mild cases these symptoms constituted the whole disease, and the patients recovered about the eighth or tenth day, after suffering for a few hours from sharp diarrhœa. In many instances, however, the patient, in addition, suffered from mild or severe sore throat, or a cough came on and continued for many weeks. In a few cases the symptoms were of a more aggravated character, the fever being more marked, the pulse accelerated, the skin hotter, and the cough more troublesome; and this has often been followed by inflammation of the lungs.

Inflammation of the substance of the lungs seldom occurred till the second or third day, and more commonly not till the fifth or sixth day; and although generally, was not always preceded by shivering, or even by bronchitis. The pneumonia in some years has been characterized by well-marked symptoms, as pain in the side, dyspnœa, and by purulent or sanguineous expectoration, so that nobody could mistake it; but in general the pneumonia has been adynamic in character, and presented a striking contrast to the usual symptoms, there being scarcely any local pain, the pulse, ordinarily so large and full, has been slow and small, and though sometimes counted between 80 and 90, has ranged more commonly from 60 to 70. The face also, instead of being full and red, has been sharp and pale, the lips blue, and the extremities cold. The patients also, who generally preserve a good deal of power in the ordinary forms of pneumonia, were now so weak that they were obliged to be supported while auscultated; and even this mode of exploring the chest did not afford the usual indications, for crepitation was rare, and the

respiratory murmur heard, except in a few points, all over the chest, while there was little or no bronchophony. The expectoration likewise had not the characters observed in simple pneumonia, for instead of being purulent and mixed with blood, it was thin, transparent, and viscid, and, if fever accompanied it, it was usually of an adynamic character, marked by a brown tongue, an accelerated pulse, and occasionally by delirium.

The appearances of the sore throat have been already mentioned, and its character was generally asthenic, and only in a few instances of a sthenic character.

Diagnosis.—It is extremely difficult to say in what influenza differs from a common cold, either in its symptoms or in its consequences. It seems probable, however, that they both depend on the action of the same poison, varying perhaps in intensity and general diffusion. In the year 1783 it was conceived that the debility which always accompanies the influenza, and the rapid manner in which it was formed, give the most obvious distinctions, and perhaps no better diagnosis can be found.

Prognosis.—Children and persons under 40 died in a very small proportion, unless in a previous state of ill-health. The mortality, however, among the aged has in every country been great from this disease. It has been remarked, also, that the disease, if not fatal in itself, left the patient, of whatever age, often greatly debilitated in body and depressed in spirits, and that those with tender lungs frequently fell into phthisis, or continued to cough for several months afterwards, so that a complete recovery was often long and tedious.

Treatment.—As a general rule the great majority of cases in these epidemics have scarcely required any medical treatment. In that of 1782 it was observed that "many indeed were so slightly indisposed as to require little or no medicine; nothing more was wanted to their cure than to abstain for two or three days from animal food and fermented liquors, and to use some soft diluted tepid drink. A lenient purgative at the beginning of the disease was useful in moderating the fever, and nature seemed to point out the repetition of it afterwards when there was pain in the stomach and bowels and a tendency to diarrhœa. The same was observed in 1762. Nothing likewise was observed so successfully to mitigate the cough as to open the bowels with a gentle purge, and afterwards to give a gentle opiate at night.* In the year 1837 it was also remarked, as long as the symptoms were limited to cough, hoarseness, headache, or other pains moderate in degree, that the patients all recovered by putting them on a low diet, by attending to their bowels, and confining them for a few days to the house; and if more was attempted it was quickly found that the disease ran a course scarcely influenced by medicine. A smaller number, however, required medical attendance, either from the severity of the bronchitis, the occurrence of pneumonia, of angina, of the disordered state of the bowels, or more often from the debility induced by the disorder.

In general when the bronchitis was severe, but the substance of the lung as yet unaffected, leeches to the chest, or cupping, or moderate bleeding were borne extremely well, and the patient relieved; while in the aged, blisters to the chest, followed by a series of linseed poultices, were often of essential service; and this treatment, together with neutral salts, opiates, and diaphoretics, in general effected the cure. In all the great influenze, however, it has been remarked that the whole class of expectorants were either useless or uncertain in their action.

In pneumonia it has been found, that although a few persons bore the loss of a considerable amount of blood, yet in general that blood taken beyond a very limited quantity, as 12 to 16 ounces, either did not relieve the complaint, or was actually prejudicial. It is in this form of pneumonia that large doses of the antimonium potassio tartarizatum have been found so advantageous. Indeed it seems distinctly proved that this form of pneumonia will not bear that powerful antiphlogistic treatment which is necessary when it arises from general causes and is of a more sthenic character.

When the patient was affected with angina, it yielded readily to the usual law of treatment of that affection, or to small bleedings when the tonsils were swollen, and to small quantities of wine when the tonsils presented little or no increase of size. The derangement of the bowels also readily yielded to the usual laws of their treatment, or to purgative medicines when constipated, and when affected by diarrhœa and accompanied by pain, to mild purgatives and opiates, or else to the pulvis cretæ compositus c. opio.

When the fever and other immediately alarming symptoms of the influenza had ceased, there frequently remained a teazing cough, and the convalescents in general complained of languor, want of appetite, and that their sleep was broken and unrefreshing. For removing these complaints, change of air and riding on horseback were most effectual, and to some they were absolutely necessary; and in addition to these, mild tonics, or else the natural chalybeate waters drank at the spas were of singular service.

Dietetic and Preventative Treatment.—In slight cases it was sufficient to limit the patient to white fish and puddings, and in the severer forms to slops and light puddings. The night air was universally prejudicial. It does not appear that any precautionary treatment was of service in preventing the spread of this disease among the attendants on the sick; for when four-fifths of the population were labouring under the disease, it can hardly be considered as having spread by contagion.

We must here conclude this short elementary account of the wide-spreading pestilence, and of the many other direful forms and shapes of disease, and of our imperfect means of curing or assuaging them. Death, however, produces life, and we may add—

> "Many are the ways that lead
> To his grim cave, all dismal; yet to sense
> More terrible at the entrance than within."

* *Med. Trans.* vol. ii. p. 71.

INDEX TO THE ELEMENTS OF MEDICINE.

CLASSED ARRANGEMENT.

MEDICINE.

- Diseases arising from General Causes.
  - Diseases of Function.
    - Neuroses—Hæmorrhages—Dropsies.
  - Diseases of Structure.
    - Inflammation—Tubercle—Cancer—Melanosis—Atrophy—Hypertrophy.
- Diseases arising from Specific Causes.
  - All Diseases from Specific Causes have a tendency to alteration of Structure.
    - Atmospheric—Animal—Telluric.
      - Poison re-generated by the Patient's person.
        - Infectious and Contagious—Contagious.
      - Poison not re-generated by the Patient's person.
        - Neither Contagious or Infectious.

Diseases of Function.

Class I. Order I.—The Neurosis.

Class II. Order II.—Hæmorrhages.

Class I. Order III.—Dropsies

MISCELLANEOUS INDEX.

SURGERY.

Surgery. General remarks on the Division between Surgery and Medicine.

Surgery, or Chirurgery (χειρ, the hand, εργον, a work), a name originally given to that very limited department of the healing art which undertakes the treatment of external injury or disease by manual interference, either with or without the aid of instruments; thus differing from the practice of physic, properly so called, which has for its object the cure of internal diseases by the administration of drugs, the regulation of the diet, or other measures of a general kind. But in the present day the word Surgery implies much more than seems originally to have been intended by it, inasmuch as it has been found impossible, consistently with the safety of the sick, to carry out in practice the distinction above mentioned. At one period of the history of civilized nations a clear and definite line was actually drawn, by which the surgeon was strictly limited to the performance of operations, the application of bandages, ointments, &c., while the physicians, assuming the air of superior learning, deemed it derogatory to their profession to intermeddle with such things, though they claimed exclusive authority in directing their employment. The most varied and fatal experience attested the erroneousness of the principle involved in this artificial disjunction of the hand from the head. The surgeons were ignorant of all that knowledge which alone could make their operations safe and effectual: they either followed implicitly the orders of their superiors, or travelled the country as mountebanks and impostors, impudently undertaking the most serious and responsible duties without the slightest acquaintance with first principles; while the physicians were disabled from the power of giving correct advice by the total want of that practical experience which is essential to the education of the judgment.

The more deeply we carry our researches into the nature of Life and vital processes, the nearer do we approach towards the apprehension of this fundamental truth—that all the reparative as well as destructive actions that occur in living bodies are but aberrant forms of natural actions, and capable of being understood only through the medium of these latter. Hence Physiology becomes the basis of Pathology, as Pathology is the foundation of Medicine. In modern times, and especially of late years, it has been universally acknowledged that the surgeon, as well as the physician, must be thoroughly conversant in these branches of science ere he can have any pretensions to practise his profession with honour and success.

Some persons suppose, on grounds like these, that no distinction should be drawn between the physician and surgeon, but that both should bear the same title and perform the same duties. But reason, as well as experience, demonstrates that the numerous and complex details connected with the practice of each department render necessary, for the attainment of adequate skill in either, a division of labour. The whole science and art of medicine together seem too vast to be fully comprehended in the scope of a single life; and, although it must be conceded that the great mass of the profession is concerned at once in both departments, yet this is to be attributed solely to those circumstances of society which render it a matter of necessity rather than of choice. In all large communities, where wealth and numbers afford the stimulus and opportunity, and where talent is ever ready to exert itself, there will always be found persons applying themselves in a more peculiar manner to the study of one or other of the two great departments already spoken of, and even to minor subdivisions of these. Such persons, as a body, have been liberally brought up and furnished with enlarged views of those sciences which lie at the foundation of medicine; and their dedication to special branches of the healing art is most admirably calculated to extend its blessings, not merely by their personal ministration to the sick, but in particular by the improvements in medical knowledge accruing from their study and experience. It is in fact this class, with few exceptions, that has furnished by far the greater number of writers on medical subjects, and by which the most considerable advances in knowledge have been achieved. There can be no doubt that the separation of physic and surgery has been in this way productive of the very best results to both, and that nothing could be conceived more likely to impede the progress of knowledge, and to interfere with the application of its benefits, than a complete amalgamation of these twin professions. And yet it must be confessed that, partly from the bias of education and a current system, and partly from the natural proneness of mankind to undervalue or disregard what does not immediately concern them, the breach between medicine and surgery has been often widened, and sometimes their essential connexion almost altogether lost sight of by practical writers; and the tendency has been to introduce into medical literature an arbitrary division, corresponding with that followed in practice, and one that has to some extent injuriously obstructed the growth and reception of general principles and views.

In the discussion of these important subjects in the present work, it would be inconvenient not to adopt the division ordinarily followed; but, to avoid repetition, the Article Medicine is intended to embrace the principal part of the general history of morbid actions, or *general pathology*, as well as the particular account of the diseases usually termed *medical*. In the following pages we shall first introduce a sketch of the history of surgery, and then, under separate heads, treat as plainly and succinctly as we are able of some of the principal injuries and diseases which custom has assigned to the care of the surgeon, referring now, once for all, to the treatise on Medicine for much of that information which is commonly found in systematic works on Surgery.

History of Surgery.

The early history of surgery is necessarily connected

Surgery. History. with and inseparable from that of medicine, since both were originally practised indiscriminately by the same individuals, and it was at a comparatively recent period that a complete separation was made. Even without the authority of history for the fact, there can be little doubt that surgery, or chirurgery, in the literal acceptation of the word, is by far the most ancient department of the healing art. From the time of the fall mankind must have been subject to various casualties and injuries arising from mechanical violence; such injuries they would soon seek to alleviate and repair by means which the commonest observation and the simplest process of reasoning would dictate; experience, too, would early teach them something of the reparative powers of nature, and how much might be done by judiciously acting in aid of those powers. Many years must have passed away before necessity called into existence a more elaborate art of healing than this. But in process of time, as mankind departed from the natural simplicity of their primitive mode of life, and as habits of luxury and indolence crept over the world, when the once open plain became covered with the crowded city, with its attendant miseries and malignant influences,—in proportion as these changes occurred, the robust health and longevity enjoyed by the early inhabitants of the earth gave place to the effeminacy and the innumerable ills which afflict their degenerate and comparatively short-lived descendants. With the increase of disease and sickness the means adopted for relieving them have become more numerous and varied; until in these later days, with all the resources of our art, we are unable to bring many even to the very confines of old age.

gyptians. Some writers who have investigated the point assign to the ancient Egyptians the merit of having first successfully cultivated the art of medicine. It has even been said that in practice they divided it into distinct branches. This would at first view indicate a considerable degree of advancement in the art; but other circumstances seem contradictory to such an opinion. The medical practice was entirely confined to the priesthood, and must have been based on the grossest superstition: it consisted for the most part in magical incantations and other ceremonies, the efficacy of which as remedial measures must be wholly attributable to any influence they may have exerted upon the imagination. The evidence which we possess of their entire ignorance of the very elements of anatomy and physiology is a sufficient proof that their knowledge of surgery was extremely limited.

ws. In the writings of Moses there are numerous allusions to the practice of medicine among the Jews, especially with reference to the cure of leprosy. The medical treatment, which was confined to the priests, consisted in the adoption of means for the promotion of cleanliness and the prevention of contagion.

ndoos. The Hindoos appear to have possessed at a very early period a certain knowledge of medicine. We are told that there existed amongst them a law by which any one who discovered a poison, at the same time making known the antidote, was richly rewarded; but if he made known the poison without the antidote, he was punished with death. The account which we have given of the state of medicine among the ancient Egyptians and other contemporary nations, is as full as the scanty records which remain upon the subject permit. We next proceed to trace its progress in Greece, where it first began to assume the rank of a science. Surgery.

Chiron the Centaur. Chiron the Centaur is said to have introduced the art of medicine among the Greeks. We learn that he was a native of Thessaly, and distinguished for his knowledge of the arts of life; he was frequently seen on horseback, and hence arose the fabulous account of his compound form. We are told that he instructed in the art of medicine the heroes who were engaged at the siege of Troy.

Æsculapius and his Descendants. But the most distinguished among the disciples of Chiron was Æsculapius, a native of Epidaurus. His reputation as a successful practitioner must have been very considerable, if we may credit the account of his death, which is said to have been caused by the anger of Pluto, in consequence of the number of individuals whom he had rescued from the grave. So highly was he esteemed among his countrymen, that after his death divine honours were paid him. He was designated the God of Physic, and temples were erected to him in various parts of Greece. The two sons of Æsculapius, Machaon and Podalirius, accompanied the Greeks to the Trojan war, and there acquired a great reputation in the treatment of wounds. Internal diseases, which were attributed to the anger of the gods, were altogether neglected, or attempts were made to remove them by the practice of charms and incantations.

The Asclepiades. During a long period of several centuries after the Trojan war, medicine made but little progress, and the records which we possess upon the subject are scanty and unsatisfactory. The practice appears to have been exclusively confined to the Asclepiades, who were the reputed descendants of Æsculapius, and the guardians or priests of the temples erected in his honour. The treatment adopted by them consisted chiefly in the performance of certain rites and ceremonies; and the influence which they acquired over the minds of their patients was, doubtless, made use of to their own advantage. The temples dedicated to Æsculapius were converted, to a certain extent, into schools of medicine. The most celebrated were those of Cos, Cnidos, and Rhodes; the first of these is noted as having been the school of Hippocrates.

Pythagoras. Pythagoras, who lived about six hundred years before the Christian æra, has the merit of being the first who brought the principles of philosophy to bear upon the study of medicine. The introduction of a more correct mode of reasoning had the effect of weakening the strong-holds of mystery and superstition, and from this time medicine may be said to have assumed, in some degree at least, the dignity of a science.

Democritus. Amongst the most illustrious of the followers of Pythagoras is Democritus. He has the credit of having paid particular attention to the study of comparative anatomy; and there is some reason for believing that he even went so far as to dissect the human subject, in spite of the prejudices then existing against such a practice.

Hippocrates. The individual who contributed more, perhaps, to the advancement of both medicine and surgery than any other single individual either of his own or of any other age, is Hippocrates. Notwithstanding his great and deserved celebrity, a celebrity so great as to obtain for him among his contemporaries and successors the name of the Father of Physic, we have no very precise knowledge of his personal history. The history of his opinions is, however, preserved and handed down to us in his

Surgery. Hippocrates.

numerous and much valued writings. He lived about 400 years before the Christian æra; he was educated among the Asclepiades at the temple of Cos; he was a pupil of Herodicus, and is supposed to have been a descendant, in the eighteenth degree, from Æsculapius. He was not content to follow the philosophical mysticisms of his predecessors, but, taking experience as his guide, he made a careful observation of nature, and after collecting a number of facts, he sought, in the spirit of true philosophy, to deduce the general laws by which those facts might be explained. So accurate an observer was he, that many of his descriptions of disease are recognized, even at the present day, as models of accuracy and precision. His knowledge of osteology was evidently very accurate, but, with this exception, his anatomical acquirements were scanty, and his ideas in many cases singularly erroneous. This is readily explained, when we consider the prejudices then existing against human dissections, and the necessity thereby induced of trusting to an examination of the bodies of the lower animals. He did not distinguish between the veins and the arteries, but called them by the common name of φλέψ; hence the assertion, which has been sometimes made, that he in any way anticipated the discovery of Harvey, is undeserving a moment's consideration. His knowledge of the nature and functions of the nervous system was likewise exceedingly limited. In the writings of Hippocrates we meet with the first traces of physiological science; and some of his ideas upon this subject are remarkably correct and profound. We are indebted to him for the hypothesis of a principle which he calls the vital principle, which influences all parts of the body, superintending and directing its motions, and which, as it were, by a kind of intelligence promotes all those actions which are beneficial, at the same time opposing those which have an injurious tendency. Although it is upon the improvements which he effected in the practice of medicine, that is chiefly founded the great reputation of Hippocrates, yet he was evidently skilled, to a considerable extent, in the art of surgery. He is said to have been the inventor of the art of bandaging. His remarks on the effects of wounds display much accurate observation, and the treatment prescribed is correct and rational. In his treatise on wounds of the head, he points out, with much care, the circumstances requiring the use of the trepan; he appears, however, to have been somewhat reckless in the use of this instrument, and to have adopted it in some cases where the surgeon of the present day would consider it more prudent to refrain. In his directions for the treatment of fractures he has pointed out the period at which firm union ordinarily occurs; not forgetting to mention the influence which age, sex, and other circumstances may exert in hastening or retarding the formation of callus. He made use of complicated machines in reducing the dislocations of large joints; the displacements of the smaller joints he treated with comparative simplicity. He tapped the chest in cases of hydrothorax, after practising percussion to ascertain the presence of the liquid. He was evidently acquainted with tetanus, observing that in many cases small wounds in tendinous parts, such as the toes and fingers, give rise to violent and fatal convulsions. His knowledge of spontaneous gangrene is evinced by the observation that "black spots on the feet frequently increase to extensive gangrene and incurable mortifications."

Surgery. Dioctes.

During a considerable interval which elapsed after the death of Hippocrates, we meet with the names of but few individuals who contributed, in any great degree, to the advancement of medicine. His successors were, for a long time, content to follow the course of their great master, and to yield unqualified assent to all his doctrines. The only remaining names amongst the Asclepiades that are in any considerable degree distinguished are Dioctes of Carystus, and Praxagoras of Cos. The former of these obtained great celebrity for his learning and skill. He paid more attention to the study of anatomy than any of his predecessors had done; but his knowledge of this subject appears to have been very limited, and to have been chiefly derived from an examination of brutes. His idea of the vascular system was a somewhat nearer approach to the truth than any opinion entertained before him. His notion of the nature of the respiratory process was, that it served to moderate the internal heat of the body. In his pathology and practice he differed little from Hippocrates. He paid particular attention to the symptoms of diseases, and especially to those derived from an examination of the urine. In the department of surgery, he was the inventor of an instrument for the extraction of darts.

Praxagora[s]

Praxagoras of Cos was another of the Asclepiades; he paid particular attention to the study of anatomy: he first distinguished the arteries from the veins, and to him is due the merit of having first observed that the pulse may be taken as an important index of the state of the vital powers. He practised several surgical operations; he had frequent recourse to blood-letting, especially for the purpose of arresting hæmorrhage; on the whole, his surgical practice appears to have been characterized by boldness rather than by prudence; we are told that he excised portions of the soft palate in cases of quinsy; and in cases of colic he opened the abdominal cavity for the purpose of restoring the intestines to their natural condition. Aristotle deserves honourable mention here, on account of the great advances which he made in the study of Anatomy and Natural History. He was the first who pointed out the origin of all the blood-vessels in the heart, and he gave the name of aorta to the largest artery in the body. His knowledge of anatomy, however, does not appear to have been derived from human dissections.

Aristotle

School o[f] Alexandria.

After the death of Alexander, and the dismemberment of the Macedonian empire, Alexandria became the chief abode of learning. It was about 300 years before the Christian æra that Ptolemy Soter laid the foundation of the celebrated Alexandrian library, and of the school of philosophy. Here all the sciences were assiduously cultivated; and the students of medicine enjoyed many privileges which were denied their predecessors. The chief of these was the opportunity of dissecting the human subject, the bodies of criminals being given up for that purpose. The most celebrated anatomists of that period were Theophilus and Erasistratus. The descriptions which they gave had the peculiar advantage of being taken from nature, instead of being a mere repetition of the errors of those who had preceded them. They made many valuable discoveries in anatomy and physiology; of these, one of the most important is that of the functions of the nervous system. Theophilus was the first who regarded the nerves as the organs of sensation, although he continued to call the nerves and tendons by one

Theophilus.

Surgery.

name. He traced the cerebral nerves to their origin, and described the pia mater; he also discovered the lacteal vessels. The discoveries of Erasistratus were not less important. But, although they made great advances in the study of anatomy, they still retained many curiously erroneous notions of physiology. They believed that the object of respiration is to fill the arteries with the "vital air;" they supposed the air to pass from the lungs through the pulmonary veins to the heart, and thence into the arteries. Erasistratus practised surgery with such a degree of boldness, that in cases of abscess in the liver or spleen, he did not hesitate to open the abdomen to apply his remedies immediately to the diseased parts. On the contrary, he was unwilling to puncture the abdomen in cases of ascites, knowing the disease depends on organic changes which could not be removed, although temporary relief might be given, by such an operation. It is important to bear in mind that about this time, that is, soon after the establishment of the Alexandrian school, the profession of medicine was divided into the three departments of dietetics, pharmacy, and surgery, each division being exercised by separate individuals. The surgeons of Alexandria appear to have attained to a considerable degree of dexterity in many of the most important operations; of these the one most deserving of attention is that for stone in the bladder, to which, it is said, some individuals devoted themselves exclusively, and were denominated lithotomists in consequence. It was always done by them with the apparatus minor, as described by Celsus. A surgeon, named Ammonius, about this time invented an instrument for crushing a stone in the bladder, when without such a proceeding the size of the stone was too great to admit of extraction. This fact, for which we have the authority of Celsus, is a sufficient proof that the idea of lithotrity is by no means a modern one.

For a period of some centuries Alexandria produced a succession of learned men in medicine and in various other sciences. During this time Rome was beginning to extend her empire over Europe; but her people were too much occupied with warlike deeds to pay much attention to the sciences, and medicine, among the rest, was for a long time entirely neglected. Not only was the study of medicine disregarded by the Romans, but its professors were banished, and the priests, once more, undertook the cure of diseases by the performance of superstitious ceremonies and the practice of charms and incantations. After some time, however, medicine again began to be looked upon with respect, and a Greek named Archagathus established himself in Rome, and acquired a considerable reputation. But he unfortunately incurred the popular displeasure, on account of his surgical practice, which was thought unnecessarily severe and cruel; and he was in consequence banished from Rome. Some time after this, Asclepiades of Bithynia acquired great popularity as a practitioner, for which he appears to have been indebted to the strict attention which he always paid to the comfort of his patients, his regard for their prejudices, and his indulgence of their inclinations. In addition, however, to the knowledge of human nature, and of human frailties, which this method of practice would show him to be possessed of, he appears to have been an accurate observer of disease. It is said that we are indebted to him for having first divided diseases into the two classes of acute and chronic,—a division which the observation of subsequent ages has shown to have a foundation in nature.

Celsus.

The name of the first native Roman practitioner that has been handed down to us is that of Aulus Cornelius Celsus. It is curious that the history of an individual of such great and deserved eminence should be involved in considerable obscurity. We are uncertain as to his age and origin; and even the nature of his profession is doubtful. His work, *De Re Medicâ*, is, however, sufficient proof of his having devoted much time and attention to the study of disease and its mode of cure. He defends the study of anatomy against the empirics, who totally disregarded it. The description which he gives of certain parts of the back proves that he must have dissected the human subject, but his knowledge of some other parts appears to have been derived from a study of the organization of the lower animals. He does not always distinguish the arteries from the veins: he has no very exact idea of the nerves, for he sometimes gives this name to tendons, and even to muscles. Many of his surgical precepts may be advantageously followed, even at the present day. His method of operating for stone has been strongly advocated by Heister as being especially applicable to children. His rules for the application of the trepan are deserving of the highest praise. He gives full directions for the treatment of fractures and dislocations. He describes the operation for cataract by depression. He mentions several varieties of hernia, and gives directions for their reduction. He speaks of the application of a ligature to bleeding vessels, when pressure and other means have failed; but he probably was ignorant of the great value of this practice, since the suggestion appears to have been entirely disregarded by his contemporaries. These examples of the practice of Celsus will suffice to show that in his day surgery had attained to a considerable degree of perfection.

Heliodorus.

Heliodorus was a celebrated surgeon who lived during the reign of the emperor Trajan. He made some excellent observations on wounds of the head and the use of the trephine. His rules for the performance and subsequent treatment of amputations differ little from those which are followed in the present day. About the same time lived Antyllus, who contributed much to the advancement of surgery, but, unfortunately, most of his writings have been lost. He recommends the performance of arteriotomy in some diseases, and directs that the vessel should be completely divided if the hæmorrhage cannot otherwise be restrained. He speaks of the operation for cataract by extraction, but recommends its performance only in cases where the cataract is small. He recommends and gives precise directions for the performance of tracheotomy in cases of threatened suffocation from diseases about the throat. He effected the radical cure of hydrocele by incisions into the tunica vaginalis.

Antyllus.

Galen.

One of the most distinguished of the ancient practitioners of medicine was Claudius Galenus. He was born at Pergamus, in the 131st year of the Christian era. He had the advantage of an extended and liberal education: he studied philosophy in the different schools which were in most repute, and subsequently went to Alexandria for the purpose of completing his medical education. At the age of 28 years he returned to his native country, and soon afterwards went to reside at Rome. Here he became a public teacher, as well as a practitioner, and the reputation which he acquired

Surgery. Galen.

excited so much jealousy and hatred towards him that he was induced to leave Rome. He afterwards returned, at the request of the emperor Aurelius, and remained there until his death, which occurred about A.D. 200. The numerous writings of Galen sufficiently evince the brilliancy of his talents and the extent of his acquirements. The opportunities of studying anatomy appear to have been at that time very limited. He considers himself fortunate in having had the advantage of studying two skeletons which were preserved at Alexandria, and recommends the dissection of apes and other animals which approach nearest to the structure of the human subject. Many of his anatomical descriptions are remarkably accurate. He made important discoveries in myology; and his knowledge of the nervous system appears to have been extensive. He practised surgery with considerable success at Pergamus; but in Rome surgery appears to have been held in disrepute, and he for the most part confined himself to the operation of venæsection when in the course of his medical practice this proceeding was required. On some occasions, however, he was more bold in operating, as we may infer from the fact of his having once applied the trephine to the sternum in a case of empyema. He seems to have taught the mode of performing surgical operations, and speaks of models of instruments that he was in the habit of showing in public. Three times he detected a dislocation of the femur forwards, and twice he observed a spontaneous displacement of that bone. He paid much attention to the use of plasters, ointments, and fomentations in all external affections; also to the art of applying bandages, and the employment of complicated machines for the treatment of fractures and dislocations.

Followers of Galen.

From the time of Galen until about the middle of the seventh century no advance was made in the science of surgery, and we meet with few names deserving of any notice. The practitioners of the third and fourth centuries are described as mere compilers, blind empirics, or miserable imitators of Galen. So implicit was their faith in every dictum of their great master, that the mere fact of any doctrine being contrary to his opinion was considered a sufficient proof of its fallacy. It was during the period of which we are speaking that literature in general was fast decaying, and the progress of science and learning was suspended, medicine sharing the fate of all other departments of knowledge. During these dark ages we find the names of a few individuals who recommend themselves to our notice, more on account of their having preserved the medical knowledge handed down to them by their predecessors, than from their having contributed in any material degree to its advancement. Oribasius was a practitioner who lived about the middle of the fourth century; his writings are chiefly compilations from the works of Galen and other eminent authors.

Oribasius.

Ætius.

Ætius lived about the middle of the sixth century: he was born at Amida, in Mesopotamia; he studied at Alexandria, and afterwards practised at the court of Constantinople. His writings contain descriptions of some diseases and some modes of practice which we do not find noticed by any preceding author. He described numerous diseases of the eye, and operated for cataract by extraction. In cases of anasarca he made incisions on the inner side of the legs. He made frequent use of the actual and potential cautery for the formation of issues. He endeavoured to dissolve urinary calculi by administering internal remedies; when these means failed he practised lithotomy. He excised hæmorrhoidal tumors, and operated for aneurism.

Paulus Ægineta.

Paulus Ægineta lived about the middle of the seventh century: he also was one of the Alexandrian school. He has devoted one book exclusively to surgery: in this he describes the different modes of treatment adopted by the ancients, by his own contemporaries, and by himself; he relates the good or bad success of many of them: he evidently has the merit of being something more than a mere copyist, and sometimes even ventures to dissent from Galen and other great authorities. In speaking of lithotomy, he insists on the importance of a free external incision and a small incision into the bladder. He describes several varieties of hernia, and the mode of operating for the relief of strangulation. He gives an account of aneurisms, and describes the operation, which consisted in cutting into the tumor, and placing a ligature above and below. He gives the history and treatment of numerous diseases of the genital organs, and mentions fractures of the patella and of the pelvis.

In the year 641, Alexandria was conquered by the Saracens under Amr-Ebn Al-As, viceroy of Egypt. The conquerors, according to common report, tarnished their laurels by the barbarous destruction of the noble library of Alexandria; but the story is very doubtful, and it is probable that the disorders and tumults to which Alexandria had previously been subject, had already destroyed this valuable collection. But at all events some works escaped, and fell into the hands of those who were capable of appreciating their value. Among these relics were the writings of Galen and Hippocrates; and we are informed that, at an early period after the establishment of the Saracenic empire, they were translated into the Arabic language, and enlarged by copious commentaries.

The Arabians.

We must now take a rapid survey of Surgery after its transfer from Alexandria, and during the prolongation of its existence in Arabia. After the Arabians had completed the conquest of a considerable part of the civilized world, the calm which succeeded seemed favourable for the cultivation of the arts of peace, and many of their rulers were most liberal in their patronage of science and literature. About the end of the eighth century, a college was founded at Bagdad, and medicine was zealously cultivated; public hospitals were built for the benefit of students, and most of the works of the Greek physicians and philosophers were translated into the Arabic language.

The study of anatomy was strictly forbidden by the Mahommedan religion; the Arabians were consequently compelled to trust for their knowledge of this subject to the writings of the Greeks. This fact we may consider a sufficient explanation of the slight degree of advancement which the Arabians made in the science of surgery. The first Arabian writer of any note is Rhazes; his works are chiefly compilations from the Greek authors; he lived about the commencement of the 10th century. He cauterized the wounds inflicted by the bites of rabid animals, and administered emetics to evacuate the "black bile." He gives some good directions respecting the operative treatment of malignant tumors.

Rhazes.

Avicenna.

Avicenna was born A.D. 980, and died in 1036. His knowledge was considered sufficiently extensive to entitle him to be designated the "prince of physicians."

Surgery.

However eminent he may have been as a physician, his surgical practice appears to have been in the highest degree inert and timid. He recommends the cure of cataract by depression, but considered extraction a dangerous proceeding. He did not operate in cases of hernia, even when strangulated.

Albucasis.

Albucasis, who died A.D. 1112, is among the most celebrated of the Arabian surgeons. One remarkable feature in his practice is the very general use which he made of caustics, by means of which he appears to have treated almost every local affection. According to him, hæmorrhage arising from a wounded artery may be arrested in one of four modes; by cauterization, complete division of the vessel, ligature, or the application of styptics. He describes the operation for fistula lachrymalis, which he performed by means of a singular instrument, provided at the extremity with a small wheel. Tracheotomy he considers useless when the disease extends beyond the bifurcation of the trachea; when practised, the membrane connecting the cartilages (not the cartilages themselves) is to be divided. His operation for stone resembles that practised by Paulus Ægineta; he describes the mode of cutting for stone in females. His treatment of fractures appears to have been attended with unnecessary severity and cruelty; indeed many of the surgical proceedings of the Arabians are unequalled in the torture which they must have inflicted upon those who were so unfortunate as to become the subjects of them. One mode sometimes adopted by them of arresting hæmorrhage from the surface of a stump, consisted in dipping the part into boiling pitch. Such was the Arabian school. The reputation which it enjoyed was very considerable, but this appears to have arisen rather from incidental circumstances than from any absolute merit which it possessed. We are indebted to the Arabians for the transmission of the works of the ancient Greeks, with the addition of certain insulated facts with respect to the description of diseases.

In anatomy, as we have before remarked, they were absolutely prohibited from making any advances. In surgery, some few improvements were made by Albucasis, but it is doubtful whether, upon the whole, the practice of surgery was not in a retrograde state during the period of which we are treating.

After the extinction of the Saracenic school, we have an interval of about 300 years, from the twelfth to the fifteenth century, during which the dark ages still remained enveloped in the deepest gloom; every department of science was neglected, and among others that of medicine fell into the lowest state of degradation.

School of Salerno.

In the beginning of the eleventh century, a medical school was established at Salerno, and obtained a degree of celebrity from its local situation, this city being one of the great outlets by which the crusaders passed over from Europe to Asia, in their expeditions to Palestine; and it was probably from this circumstance that Robert of Normandy stopped at Salerno, in order to be cured of a wound which he had received in the holy wars. No improvements appear to have emanated from this school, but it is in one respect deserving of our notice, as it appears to have been the earliest establishment in which what may be styled regular medical diplomas were granted to candidates, after they had passed through a prescribed course of study, and been subjected to certain examinations.

In the year 1163, the council of Tours prohibited the clergy, who then shared with the Jews the practice of medicine and surgery in modern Europe, from undertaking any bloody operation. It is to this epoch that the true separation of medicine from surgery must be referred. The latter was now abandoned to the laity, the generality of whom, in those ages of barbarism, were entirely destitute of education. The priests, however, still retained that portion of the art which abstained from the effusion of blood, and disgraced surgery by reducing it to a mere business of applying ointments and plasters.

Separation of Medicine from Surgery.

Gilbertus Anglicanus.

Gilbertus Anglicanus is the first surgeon among our own countrymen whose name is handed down to us. He appears to have been an industrious compiler, and to have taken great delight in scholastic disquisitions and theoretical speculations. He lived about the beginning of the XIVth Century.

During the XVth Century two events occurred which have an interest connected with the history of surgery.—The first of these was the discovery of the art of printing, about the year 1450. Towards the end of the XVth Century syphilis first broke out, and is said to have been imported from America by the followers of Columbus, but this account of its origin is doubtful.

XVIth Century.

At the commencement of the XVIth Century, the science of surgery was in a most degraded and unpromising condition; the most skilful practitioners appear to have had an invincible repugnance to all important operations, which they were content to leave to the ignorant charlatans of the day. In imitation of the Arabian school, too, they took great delight in the invention of numerous instruments and machines, each successive one more complex than the preceding, and thus they encumbered their art with new difficulties.

Beneveni.

At length Antonio Beneveni, a physician of Florence, began to insist upon a truth of the highest importance to the extension of surgical knowledge, viz.: that the compilations of the ancients and Arabians ought to be relinquished for the observation of nature. A new era now began.

Vesalius.

The moderns were convinced that by treading servilely in the footsteps of their predecessors they should never even equal, much less surpass them. The labours of Vesalius also gave birth to anatomy, illuminated by which science surgery put on a different aspect, and assumed a higher rank.

Ambroise Paré.

The most celebrated surgeon of the XVIth Century was Ambroise Paré, a native of Laval, surgeon to king Henry the Second, Francis the Second, Charles the Ninth, and Henry the Third of France. Paré practised his profession in various places, followed the French armies into Italy, and acquired such esteem, that his mere presence in a besieged town was enough to re-animate the troops employed for its defence.

His writings, so remarkable for the variety and number of the facts they contain, are eminently distinguished from all those of his time, inasmuch as the ancients are not looked up to in them with superstitious blindness. Freed from the yoke of authority, he submitted everything to the test of observation, and acknowledged experience alone as his guide. He was the first to reduce the treatment of gun-shot wounds to rational principles. He treated hydrocele by the seton. He revived the use of the ligature in the treatment of hæmorrhage. He distinguished fracture of the neck of the femur from dislocation of the head of the bone, with which it had previously been confounded. He performed tracheotomy with success, and endeavoured

Surgery. Ambroise Paré.

to cure fistula in ano by means of a ligature. His superior merit soon excited the ignorant, the jealous, and the malignant against him; and he became the object of a bitter persecution, his discoveries being represented as a crime; his fame however has survived him, and the French writers are with reason proud of their countryman Paré to this day. After the death of this great man, surgery, which owed its advancement to him, continued stationary, or even took a retrograde course. At this time the practice of surgery was associated with that of the barber, and the class of barber-surgeons continued to exist, both in this country and on the continent, for a period of nearly two hundred years. Pigrai, the successor of Ambroise Paré, was by no means an adequate substitute for him. A spiritless copier of his master, he abridged his surgery in a Latin work, when the unaffected graces of the original, the sincerity, and the charm inseparable from all productions of genius, entirely disappeared.

XVIIth Century.

In the next or XVIIth Century a fresh impulse produced additional improvements. There appeared in Italy, Cæsar Magatus, who simplified the treatment of wounds; Fabricius ab Aquapendente, the preceptor of Harvey, and less noted as a surgeon than as a physiologist; and Marcus Aurelius Severinus, the restorer of operative surgery.

English Surgery. Wiseman.

Among English practitioners during the XVIIth Century, we find the names of Richard Wiseman and William Harvey. Wiseman was a surgeon in the civil wars of Charles I., and accompanied Prince Charles, when a fugitive in France, Holland, and Flanders. He served for three years in the Spanish navy; in 1652 he settled in London. When Charles II. was restored he was made serjeant-surgeon to the king. He has given us the result of his experience in eight surgical Treatises on Tumors, Ulcers, Diseases of the Anus, Scrofula, Wounds, Gun-shot Wounds, Fractures and Dislocations, and Syphilis.

Wiseman merits the highest praise for the candour and honesty which are displayed throughout the whole of his works. His object in writing is evidently not so much to gain the repute of a skilful and successful practitioner, as to relate every fact which may be of benefit to his readers. He faithfully narrates not only the successful, but the unfortunate cases which came under his notice: the latter, as he remarks, being frequently more instructive than the former. His account of the symptoms and treatment of strangulated hernia is well worthy of perusal; and his Essay on Injuries of the Head is remarkable for the sound principles therein inculcated. He made great improvements in the treatment of gun-shot wounds, refuting the notion then generally prevalent, that such injuries had superadded to them some poisonous effect, which rendered necessary a peculiar plan of treatment. He gives excellent rules for the performance of amputation after gun-shot wounds of the extremities; and insists on the importance of amputating at once, before the occurrence of fever, in every case where the extent of the injury renders probable the ultimate loss of the limb. With all the sound sense, correct reasoning, and accurate observation displayed in Wiseman's treatise, it is curious to find him assenting to the popular delusion respecting the cure of scrofula by the king's touch. He declares that this sanative power was possessed by our kings, "At least from Edward the Confessor downwards." Of Wiseman we may say, in conclusion, that he effected for surgery in this country what Paré did in France, and is equally deserving of the grateful remembrance of his countrymen. A contemporary of Wiseman was William Harvey, whose name is rendered immortal by his discovery of the circulation of the blood. He publicly taught his new doctrine in London in the year 1619; but his work on the circulation was not published until 1628. The promulgation of this new doctrine brought on him the most unjust opposition, some condemning it as an innovation, others pretending that it was known before; however, he had the satisfaction of living to see the truth fully acknowledged and established. The discovery of Harvey, considered with reference to its effects in improving the science of surgery, must be esteemed the most important which has ever fallen to the lot of an individual to make. Before the circulation of the blood was known, how vague must have been the notions of the pathology, and how uncertain the methods of treatment of many of the most important surgical diseases, which are now comparatively well understood and efficiently treated! Our knowledge of the causes and the treatment of aneurism, the means which nature employs to arrest hæmorrhage, and the artificial methods calculated to effect the same purpose, are entirely based on the discovery of Harvey. For, although the ligature was occasionally applied to arrest hæmorrhage many years previously, they who used it must have been quite unacquainted with the true principle of its action, and the different modes of its application. The benefits which the knowledge of the circulation conferred upon the science of medicine are not less than those which surgery derived from it; indeed it is scarcely possible to overestimate the discovery of our illustrious countryman.

Surgery. Harvey.

Germany. Fabricius Hildanus.

Germany, during the XVIIth Century, boasted of Fabricius Hildanus, a successful practitioner, and author of a surgical treatise, dated 1641; Scultetus, so well known for his work intitled *Armamentarium Chirurgicum;* and Purmann and Solingen, who had the fault of being too partial to the use of numerous complicated instruments.

Holland.

Holland, restored to liberty by the generous exertions of her inhabitants, did not long remain a stranger to the improvements of surgery. There is one peculiarity connected with these improvements which claims the notice of the historian. Ruysch, who was an eminent anatomist, carried with him to the grave the secret of his admirable injections. Roonhuysen also made a secret of his lever, which before the invention of the forceps was the only resource in difficult labours. Raw, who successfully cut fifteen hundred patients for the stone, took such pains to conceal his manner of operating that Heister and Albinus, his two most distinguished pupils, have each given a different explanation of it. Such a disposition would materially have retarded the progress of surgery in Holland, had not Camper, in the following century, effaced the imputation by the great number of his discoveries, and his zealous desire to render them public.

Ruysch. Camper.

France.

From the time of Paré, until the commencement of the XVIIIth Century, surgery was but little cultivated in France. Mauriceau, Saviard, and Belloste, were the only French surgeons of note, who could be contrasted with so many eminent men of other nations. During the XVIIIth Century, France produced two surgeons of extraordinary genius; these are Petit and Desault. Petit was one of the first and most distin-

Surgery. Petit. guished members of the Royal Academy of Surgery. At an early period of his life he published his *Traité sur les Maladies des Os*, a work which was long esteemed the best on the subject. To him we owe the invention of the screw tourniquet. His progress was most violently opposed by envious critics, and it was not until after many years of labour that his superiority was acknowledged, and he was unanimously elected the head of his associates. Desault. Desault has the reputation of an accomplished anatomist and a skilful surgeon. He invented the straight splint for fracture of the thigh; the simplicity and usefulness of which is now a matter of daily observation. About the same period flourished the following eminent French surgeons; Le Dran, Morand, Chopart, Mareschal, Garengeot, Louis, Sabatier, Quesnay, Maître Jean, the inventor of the Lithotome Caché, Le Motte, Le Cat, &c.

XVIIIth Century. During the XVIIIth Century, Great Britain could boast of the following celebrated names:—Cheselden, the two Monros, Cowper, C. White, Pott, Hawkins, Smellie, and Hunter. The name of Cheselden is so intimately associated with the operation of lithotomy that a short notice of the various modes of performing the operation may, appropriately, precede our account of the improvement which he effected. Cutting for the Stone. The most ancient kind of lithotomy was that practised more than two hundred years ago by Ammonius, of Alexandria. It is the same as that described by Celsus, and has been called *cutting on the gripe*, or the *apparatus minor*. In operating by this mode two fingers were placed in the rectum, the stone was pushed forwards, and made prominent on the left side of the perinæum. A lunated incision was then made through the skin and cellular tissue, directly on the stone, near the anus, down to the neck of the bladder. Then a second incision was made on the stone into the neck of the bladder. The calculus, being strongly pressed upon by the fingers, next started out of itself, or was extracted with a hook constructed for that purpose. The operation by the *apparatus major* was first published by Marianus Sanctus, in 1524, as the invention of his master, Johannes Romanus; it was founded on a dictum of Hippocrates, that *wounds of membranous parts are mortal*. A grooved staff was introduced into the urethra; the membranous part of the canal was opened, an instrument was passed through the prostatic portion of the urethra by which the prostate was forcibly dilated and lacerated; when this was carried to a sufficient extent, the stone was extracted by forceps. The *high operation* was first practised in Paris, in 1745, by Colot. In operating by this method an incision was made in the median line above the pubes; the bladder was cut into, and the stone extracted by forceps. The lateral operation was invented by Franco, and subsequently improved by Frère Jacques, who came to Paris in 1697, and cut many patients at the Hôtel Dieu and La Charité. Frère Jacques used a large round staff, in his early operations, without a groove, but afterwards he adopted a grooved staff. After the introduction of the staff he plunged a long knife into the left hip, near the tuber ischii, and pushing it towards the bladder, opened it in its body, or as near the neck as he could. The improvement which Cheselden effected upon this last operation consists in opening the bladder by cutting through the left lobe of the prostate; and in his last modification of it he first plunged the knife into the bladder behind the prostate, and then divided the latter, as well as a part of the membranous portion of the urethra, from within outwards. Surgery. The lateral operation, with the internal incision not carried beyond the prostate, is the one almost invariably adopted at the present day.

Percival Pott. Percival Pott contributed greatly to the improvement of surgery in England, by abolishing many of the severe and painful measures which were previously in vogue, by the introduction of more rational modes of treatment, and by his admirable descriptions of surgical diseases and injuries. We need only allude to his account of injuries of the head, and their treatment; his history of diseases of the vertebræ, attended with paralysis of the limbs; his celebrated essay on fractures, and his valuable remarks on amputations. He is spoken of as being in his time "the best practical surgeon; the best lecturer; the best writer on surgery; the best operator of which this large metropolis could boast." John Hunter. A man of greater genius and originality than Pott was John Hunter, who was at once eminent as a surgeon, an anatomist, a physiologist, and a naturalist. An enumeration, in this place, of the invaluable improvements which he made in the practice of surgery is impracticable; we would refer our readers to his treatises on inflammation, on the blood, and on the venereal disease, and would especially direct attention to the vast improvement which he effected upon the old operation for aneurism. Before the time of Hunter, the operation was performed by cutting into the sac of the aneurism, and tying the vessel above and below. So formidable was this proceeding in its consequences, that amputation of the limb was frequently preferred as a less dangerous and fatal measure. The genius of Hunter led him to tie the femoral artery in a case of popliteal aneurism, leaving the tumor untouched. The safety and efficacy of this mode of operating have now been fully established, and the principle has been extended to all operations for the cure of this formidable disease.

Italy. While in Great Britain the preceding distinguished men were raising the character of their profession, Lancisi, Morgagni, and others were pursuing a corresponding honourable career in Italy. Of late years, the credit of the Italian school has been well maintained by Monteggia, Scarpa, Assalini, and others. In Holland flourished Albinus and Camper. In Germany, Haller, Heister, Soemmering, and a long list of zealous and successful cultivators of anatomical and surgical science.

Present Century. In the rapid enumeration which we are giving of the names of those individuals who have chiefly contributed to raise surgery to the high position which it at present occupies, we must not omit to mention the names of Baron Dupuytren, Abernethy, and Sir A. Cooper. The former has lately closed a career of unusual brilliance in Paris, leaving behind him a series of highly valuable observations on most of the great subjects of surgery, and a reputation for boldness, skill, and judgment, the remembrance of which will not speedily be effaced. John Abernethy was eminently distinguished both as a practical surgeon and a philosopher, and by his enlarged views and sound understanding did much to extend the application of Hunter's doctrines to the management of disease. In particular he strove to impress on the minds of surgeons the reality and importance of the connexion existing between various local maladies and an impairment of the

Sir A. Cooper.

general health, in his celebrated Essay on the *Constitutional Origin and Treatment of Local Diseases*, a treatise that exercised great influence over the profession at the time of its publication. Sir Astley Cooper has more recently terminated a life marked by zeal and activity which remained unabated even to its very close. "His published works will remain as long as surgery is cultivated, and especially the treatises on Hernia and Dislocations, replete with important facts, and containing the clearest rules of diagnosis, will transmit his name to posterity with those of Sydenham and Hunter, as a benefactor to the human race."

Influence of war on the progress of Surgery.

In looking back on the history of Surgery, we may remark that its progress has been singularly influenced in two ways: viz., by war—and the institution of hospitals. The wars of civilized nations have seldom proved unmitigated evils, and one of the benefits they have conferred has been the encouragement they have afforded to the cultivation of surgery. Perhaps the earliest recorded instance of the regular practice of this art is to be found in Homer, as having occurred at the Trojan war; and even though we reject the authenticity of the narration, as matter of history, it must at least be admitted as evidence that such pursuits were systematically followed by a particular family or class, as remotely as the age of the poet. Ambrose Paré, the great reviver of surgery in France, and Wiseman, the father of English surgery, were both trained and taught in this school; and it may be doubted if in any other they could have contributed so largely to its improvement. In the camp and in the field, indeed, the intellectual energies of those on whom the safety of their fellows depends, are awakened in a way to which the ordinary occasions of civil life afford no parallel. In later times a host of eminent names attest the benefits derived to science from this great source of experience.

Hospitals.

With regard to hospitals, we cannot do better than quote the following remarks of Mr. Arnott, lately made in a lecture delivered at King's College, London, on the occasion of the establishment of the hospital, now connected with that institution, and bearing its name.

"Before the introduction of Christianity," says Mr. Arnott, "Hospitals were unknown. Among the most polished nations of antiquity, the Greeks and Romans, it is in vain to seek either in their annals, or in the remains of their once proud cities, for a trace not only of hospitals, such as they now exist, but of any charitable institutions for the reception of the poor, the orphan, and the sick.

"After the introduction of that religion which looks upon all men as equal, and which inculcates charity as a duty, its disciples at an early period contrived a scheme for the assistance of their necessitous brethren; but this did not, until the fourth century, assume the form of institutions for their reception. * * * As there were then no inns for the accommodation of strangers, when in foreign countries or at a distance from home, it was usual for travellers of that nation (the Roman) to be received at the houses of certain persons, whom they in their turn entertained in Rome. The connexion thus established was considered an intimate one, and was styled '*hospitium, jus hospitii*.' The former term was also applied to the reception of a stranger, and to the house or apartments in which he was entertained; and the Roman nobility used to erect the latter, called *hospitalia*, on the right and left ends of their houses, with separate entrances. From these our 'hospital' is derived. * * *

Hospitals.

"With the institution of religious orders, a prominent part of whose duty it was to solicit alms, to tend the sick, and to succour the afflicted, the number of hospitals increased, and from this source it is ascertained that some of the oldest and largest hospitals in this and other countries of Europe have arisen. St. Bartholomew's was originally connected with a priory, as likewise was St. Thomas's, both hospitals being in existence centuries before the time of Henry VIII. La Charité arose in the same way, and the Hôtel Dieu was attached to the adjoining Cathedral of Notre Dame. * *

"Originating with the Christian priesthood, often associated with the principal church of the places in which they existed, and very generally constituting a part of some religious house, it was natural that the care and management of all hospitals should primarily devolve on the clergy,—on those through whose aid, and presumed powers of intercession with Heaven, restoration to health was looked for and expected. Nor is it surprising that this control should have been retained during the dark ages, and even for a considerable time after the general revival of intellectual activity in the twelfth century. * * It was not until a considerable time subsequently that the influence of hospitals upon the progress of medicine was felt—not until it had been preceded by the more ardent and successful cultivation of anatomy in the sixteenth and seventeenth centuries, and in this country not until there had been adopted less stringent regulations with respect to the admission of pupils to these charitable institutions.

"At the commencement of the last century there were but two hospitals in London for the sick and lame—St. Bartholomew's and St. Thomas's; and the governors of these wholly refused to allow the education of pupils in the one, and would only admit nine at a time in the other. They afterwards relaxed, and in somewhat more than half a century later, had so completely changed their views that they built and attached theatres to their hospitals, for the teaching of anatomy and the lecturing on surgery, which up to this time had been carried on in private establishments only. St. Thomas's had the priority in this respect, the anatomical theatre having been built there in 1768; at Bartholomew's, although Mr. Pott was appointed lecturer on surgery in 1765, an anatomical theatre was not built till twenty years afterwards. These changes, together with the ready access of pupils to the more recently erected hospitals, had most important effects on the progress of medicine. As an evidence of this, consult the works produced on surgery since the first third of the last century, the Memoirs of the French Academy, the writings of Pott, Hunter, Petit, Desault, Sabatier, Abernethy, Home, Boyer, Scarpa, Hey, Dupuytren, Cooper, Delpech, and of many minor and other living surgeons, and it cannot fail of being remarked how much of the statements, of the opinions, and of the practice of the authors, is based upon the observations made in and on the experience furnished by the hospitals to which they were respectively attached. * * * *

"There, also, patients are placed in circumstances and under a degree of control much more favorable than elsewhere for witnessing the course and termination of disease, for ascertaining the effects of remedies, and for investigating, in cases of fatal result, the appearances

met with after death. No other institutions afford equal opportunities for acquiring a familiarity with operative surgery—not only the operations themselves, but the treatment of the cases before and afterwards. * * *

"From what has been stated, it will have been inferred that the value of hospitals as schools of medicine has been for a considerable time felt and acted upon in England. But the best method of making available these advantages has only been pursued within a very limited period. In so far as brief remarks, made occasionally and regularly at the bedside, constitute clinical instruction, this has probably been practised from the first admission of pupils to these institutions. But the system of taking individual cases of disease, and making them the subject of lecture, was in the first instance adopted in Holland, at Utrecht, and Leyden. Thence it extended to Pavia, Vienna, and Edinburgh, and was for a long time confined to these schools, and applied to physic only. Desault, in the Hôtel Dieu, first employed the method systematically in the teaching of surgery. In this metropolis it was, I believe, first introduced by Sir C. Bell. The regular application, however, of clinical teaching in both departments of medicine as an essential part of education, is but of yesterday."

Operations.

Operations have been called the opprobria of surgery; and where they are ill-advised or ill-executed, they may be deemed justly liable to this condemnation. In the days when the most important operations were commonly performed by empirics, whose impudence and conceit were only equalled by the profoundness of their ignorance,—and when even those few professors who were best versed in the subject were for the most part unacquainted with anatomy, and could only employ for the arrestation of hæmorrhage means both barbarous and inefficient, operations were naturally looked upon as revolting expedients, for the terrors of which their ill success could afford but a poor compensation. But a little reflection will show that it is unfair to charge that as an inherent disgrace on surgery which is imputable only to the darkness of a by-gone age, or to a want of knowledge, or judgment, or principle, on the part of its individual professors. We will even so far put ourselves into the position of advocates as to say that operations such as are now so extensively practised with judgment, humanity, and skill, are the glory of surgery, and are likely to remain so, as long as man continues obnoxious to accident and disease. What can be a more noble exercise of art than to save life and prevent or terminate protracted suffering by a speedy and dexterous operation? When, for example, some foreign substance has dropped into the windpipe, and threatens impending suffocation, what an admirable and rational interposition is that by which the surgeon opens the tube below the narrow chink at its orifice, and gives exit to the offending substance. What numerous instances do we not know to have occurred where this accident has, without this seasonable interference, proved quickly fatal. Or again, in that frequent and dreadful malady which consists in the slow formation of an earthy concretion in the urinary bladder, attended as it usually is by the most severe tortures, making life unendurable long ere it exhausts it by the gradual effects of pain and organic disease; how worthy of commendation is that brief procedure by which the practised surgeon apprehends and removes the source of his patient's misery! And a thousand examples might be added to these in proof of the same thing.

It is indeed but too true that, even in the present day, operations are often undertaken and performed with but small chance of benefit, and that some of those which appear promising in their results eventually prove useless, and even accelerate a fatal issue. Sometimes this arises from idle or hopeful delay on the part of the sufferer or his friends, until the most propitious season is past; sometimes from the oversight or irresolution of the surgeon; and very frequently from the originally disastrous and malignant nature of the disease itself. Some operations are essentially dangerous from the structures involved, or their proximity to deep-seated or vital organs; some from the constitutional debility or cachexy of the general system; and others from the deficiency of the means and attendance which the subsequent progress of the case may demand. And the universal experience of surgeons declares, that not even the most trivial operation can be pronounced absolutely free from danger, since it may prove the starting point of a spreading and fatal inflammation, or of some disproportioned sympathetic affection of the nervous system (such as tetanus), of which the progress of knowledge has not yet divulged either the nature or the remedy. But making due allowance for these and many other circumstances, which in actual practice present themselves under ever-varying complications, we must conclude that they are rather difficulties and uncertainties referable to the imperfection of our control over vital actions, than blemishes on the art of surgery. Practical wisdom must decide that, taking circumstances as they are found in reality to be, operations must, in numberless cases, prove an inestimable blessing to mankind.

But while we say this, we would point with extreme satisfaction to the progress of modern surgery in alleviating the suffering and danger of operations, and in materially restricting their numerical amount. By a more exact acquaintance with surgical anatomy, by a more dexterous use of instruments by surgeons in general, and more especially by an early resort to those prophylactic or remedial measures which ward off the dreadful necessity for the knife, the future historian of Surgery will probably characterize the main tendency of the improvements of the passing age. But it will also be a signal distinction of our own day, that many new procedures have been devised to remove diseases or unsightly deformities formerly set down as incurable; and that many old ones have been supplanted to a greater or less degree by others adapted to the improved state of physiology and medicine. We shall exemplify these remarks when recounting the treatment of particular maladies.

Deciding on operations.

Deciding on Operations.—It is difficult to lay down any general rules on this subject, in consequence of the infinite variety of circumstances in different cases. Many operations are urgently demanded for the immediate preservation of life. Such, generally, are those for strangulated hernia, for fractures of the skull with depression, and very many more. Others may be safely delayed for a certain length of time, without prejudice to the patient's welfare, such as lithotomy or lithotrity under many circumstances; while others of minor im-

portance may be regarded more or less as measures of convenience rather than of safety, and will admit of being deferred until every circumstance shall appear the most favourable. In these latter cases, every prudent surgeon will consult the well-being of his patient not less than his own reputation, and that of his art, by a careful selection of the period of operation. Winter and spring are usually the best seasons in which to undertake operations; and autumn is the worst, on account of the atmospheric condition, and the frequent prevalence of erysipelas, especially in hospitals, at that time. Hot weather makes recovery more difficult, and increases debility and prostration, both by encouraging cutaneous evacuations, and by directly depressing the nervous system. It also appears to augment the tendency to undue vascular action in wounds. In some seasons erysipelas is epidemic, and it is apt to linger in an endemic form where it has once committed its ravages. Under either of these circumstances, all those operations must be avoided that are not absolutely necessary.

In judging of the propriety of an operation, the state of the whole system and of the internal organs must be carefully inquired into. Want of attention on this head, has often led to the infliction of needless suffering, and even hastened instead of retarding the fatal termination. Thus we have ourselves witnessed the performance of an amputation for the removal of a foot, the bones of which were disorganized by struma,—and where the unhappy boy bore within him the somewhat advanced seeds of consumption, to which disease he fell a victim a few weeks afterwards. Thus also in malignant disease, the general voice of the profession conspires to condemn its removal by the knife, where there exists sufficient evidence of its presence in parts to which this remedy cannot be applied: and some surgeons are even disposed to the plan of non-interference in many instances, where such evidence is far from being conclusive. Under all circumstances, calmness and resignation in the patient will be hailed as the omens of a happy result, and the opposite conditions of alarm, irritability, and excitement must weigh heavily against him. On this account, when an operation is resolved upon, an important part of the surgeon's duty will be to re-assure his mind by kindness and encouragement, which will be done more effectually by a mild and cheerful behaviour than by words. One under the anxiety of an approaching operation, the magnitude and pain of which his fears will incline him to overrate, and which seems critical of his fate, will derive from this source an amount of consolation and fortitude only to be conceived by those who have been in the position to experience them.

It will be advisable to prepare the system for the shock it is about to sustain, by employing those measures which have a tendency to restore strength or to diminish plethora. The functions should all be brought into as healthy a condition as the time and circumstances will allow. With some surgeons it is a favourite practice to reduce the powers of the system below the natural standard, with the view of diminishing the chances of subsequent inflammation. In some peculiar cases, where this accident, even though slight, might put an important organ in jeopardy, and mar the success of the operation, as in extraction of the cataract, this is generally adopted as a prudential step; but as a practice before ordinary operations, it is universally discarded, at least in this country. There is, on the contrary, a growing opinion in favour of a more free exhibition of tonics and stimulants, both before and after the great operations; and experience seems to declare that, at least in capital cities and among large manufacturing and commercial communities, such a course is indispensable.

With respect to the conduct of an operation, it has been well said that "three things are required,—a cool head, a quick eye, and a steady hand." Much must be given by nature, but more by education, to form the distinguished operator. He must possess coolness, presence of mind, and a certain physical strength of purpose, which will not allow itself to be diverted from the object which the judgment has sanctioned, by any ill-timed weakness or vacillation. But these valuable endowments could only lead to the most culpable rashness in an operator who was deficient in those more solid qualifications which knowledge alone can supply. He must be well and practically versed in the anatomy of the body, particularly of those regions which are liable to diseases calling for his interference; and he should moreover have studied the changes which disease or injury may work in their texture, or relative situation, so that when he encounters unnatural conditions, he may not be dismayed and thrown off his guard by his inability to comprehend their import.

Before commencing an operation, it is essential that everything requisite for its completion should be at hand, that delay may not be occasioned when it is so little compatible with the welfare of the patient. With this view, the whole should be previously pondered in the surgeon's mind, every step dwelt upon, and possible contingencies foreseen; he should have first operated *in imagination*. His instruments will be then at hand and in good order, there will be duplicates of those which may be liable to injury, and he will be furnished with means for arresting hæmorrhage. If the proceeding is conducted by candle-light, he will have several lighted in case of accident. The patient should be placed in such a posture as may best conduce to the successful performance of the operation; and his own ease should be consulted, that he may not be fatigued ere it be finished. This is a circumstance that is more attended to in the present day than formerly, especially in our public hospitals. But in some particular cases, such as lithotomy, it is still an universal practice to fix the patient so that he cannot change his position by his struggles—an accident likely to be followed by the most unfortunate consequences, in an operation where so many important parts are crowded together in the small region in which it is performed.

"Everything being got ready," says Le Dran, "the Surgeon begins the operation, which should be done *expeditiously* and *effectually;* expeditiously, because every moment of suffering appears long: nevertheless the operator must allow himself sufficient time, and when I used the word *expeditiously*, I only meant that he should not lose time, taking great care not to be over hasty, lest his hand out-run his judgment, which should direct it. An operation is always soon enough done that is well done. He is likewise to operate effectually, that is, in such a manner as not to be obliged to renew the operation, or to make fresh incisions. If the case requires that the operation should be done at twice, or if he plainly foresees there will be abscesses and sinuses which must be afterwards opened, he ought to mention this beforehand, to prevent the patient

Surgery.

being alarmed when it happens, as well as to preserve his own character. In performing the whole, he should endeavour to give as little pain as possible, and not to incur the imputation of cruelty."

Amputation.

We shall conclude this subject with some remarks on one the most important operations in surgery, viz., *amputation*.

By this operation, a limb or other projecting part of the body is cut off. When it has been determined to sacrifice a member on account of disease or injury, the surgeon's attention is directed principally to three points, viz.:—to prevent unnecessary hæmorrhage—to provide a useful and healthy stump, and to heal the wound with speed. Where arteries of large size are necessarily divided, the bleeding abandoned to itself would be fatal. It is therefore requisite to compress the main artery of the limb before the operation is commenced. This is usually done by means of an instrument devised for the purpose, and called a *tourniquet*. This consists in a girth encircling the limb, and capable of being tightened or slackened at will by a simple contrivance moved by a screw—and its effect of pressure on the main vessel is increased by a compress of cork or other material adapted to that part. But this apparatus is by no means essential to the prevention of hæmorrhage, and in the case of many arteries, such as those of or near the trunk, it cannot be employed—many surgeons reject it altogether, preferring the judicious and well regulated compression of the artery by the finger or thumb of an assistant familiar with the anatomy of the parts. It is certain that a very slight pressure, rightly applied, will be amply sufficient to obstruct the flow of blood through the vessel, and the tourniquet is liable to the objection of giving the same sense of security, whether it is well or ill applied. When used, it should always be adapted to the limb by the surgeon himself, and especially when he has not full confidence in his assistants. When the limb is off, the orifices of the divided vessels are seen on the surface of the stump. They are then to be taken up, and secured by ligatures on the principles which will be explained under the head of hæmorrhage—after which the pressure on the arterial trunk is to be removed.

To provide an useful and healthy stump, many circumstances must be duly weighed and attended to. The principal object is to secure an ample covering of soft parts, especially of skin for the end of the bone, otherwise this will protrude by the recession of the muscles, and will then exfoliate, and to say the least, will necessitate another operation, and after all leave the limb more or less useless. Such were the lamentable conditions consequent on the old amputations—and which ensue on the natural process of separation of a limb which has perished by mortification. To obviate such occurrences, the surgeon has to shape his incisions in a particular fashion—the great object of which is to divide the bone at a higher point than the investing structures, so that even after the retraction of these consequent on the elasticity of the skin, and the contractibility of the flesh, there may be enough substance left to be brought over the end of the bone, and to give it an abundant cushion-like covering. Two methods are currently practised with this end in view, of which we may here offer a short account. These are the *circular* and the *flap* operations.

Circular Amputation.

In the *circular* operation, the knife is first carried transversely round the limb, through the skin and subcutaneous fascia only. These structures are then dissected upwards from the deep fascia and muscles for an inch or more, according to the size of the limb and the extent of covering required. The second incision is then made through the muscles at the highest point at which they are exposed by the previous dissection, and they are divided either at one or two strokes, down to the bone. They are then usually pulled upwards by an assistant, and a still higher section made of those fibres that lie close to the bone. Thus the bone is exposed on a level from three to six inches higher than the first incision through the integuments. The bone is now sawn through with an ordinary saw, the fleshy parts being, by many surgeons, held back by means of a piece of linen, called a retractor, adapted to preserve them from injury by the saw. The employment of the retractor will be determined by the circumstances of the individual case.

Amputation by flaps.

In the *flap* operation the skin and muscles are cut at once in a slanting direction on each side of the bone, and the latter divided at the acute angle thus formed between the flaps; so that the dissection of the skin from the muscles is avoided, and the operation is thus shortened. The flaps are usually made by first thrusting the knife through the limb close to the bone, and cutting outwards and downwards, but they may be made by commencing on the outside and cutting upwards towards the bone. The former, however, is in general both the more expeditious and the more easy plan. There always remain some few fibres near the bone, which have to be divided by a circular sweep of the knife, after which the flaps are held back, and the bone sawn through, as in the circular method.

It is not our intention, nor is this the place, to discuss at any length the comparative advantages of these two modes of operating. We shall confine our remarks upon them within very narrow limits. The circular method is the longer in its performance, but in the hands of a good operator it ought seldom to exceed a minute or two. The flap may generally be performed in even less time. The circular is attended probably with rather more pain, from the dissection of the skin from the muscles, which it entails, while the flap has the occasional disadvantage of dividing the vessels obliquely, and leaving the nerves long on the face of the stump, circumstances which may render necessary some little further cutting after the limb is already severed. With regard to the stumps that are to be formed by these two methods, it would appear that most excellent ones may result from both under proper hands and with suitable care. Of course the circular operation gives less fleshy stumps than the other, and affords a less mass of covering for the end of the bone. But the fleshy cushion that the flap affords often wastes remarkably at some period after the operation, and when pressure comes to be made habitually upon it. It is also more liable to include the extremities of large nerves, which when enlarged, as they usually become, into a bulbous form, may prove troublesome in the attempts to make the stump useful as a support. On the whole it must appear on a dispassionate view of the respective merits and demerits of the two methods, that there is so little essential superiority in either, that their adoption in practice will constantly be determined by the particular region operated on, or by the taste or fancy of the surgeon.

With respect to the third point we have adverted to,

Surgery. Amputation.

viz. the speedy healing of the wound, we shall have little to say. In this country there happily exists no difference of opinion on the question whether the surfaces of the wound should at once be brought together within a few hours after the operation, to heal as much as possible by the first intention, or whether they should be kept apart by sponges or charpie, with the intention of inducing suppuration and slow union by granulation. It is the proud boast of English surgery that it was the first to advocate the former of these methods, and that it has always supported the practice by argument and example against the adverse opinions of some of the most eminent continental surgeons. If this plan be followed, the stump will be healed in ordinary cases in three weeks or a month, and it seems certain that no injury can arise from the judicious attempt to unite the wound by adhesion, even should that attempt unfortunately fail, for the surgeon will of course be on his guard to loosen the bandages, if the tumefaction or pain seem to indicate the necessity of doing so. The wound made by the amputating knife is to be treated on precisely the same principles as are applicable to ordinary incised wounds.

Wounds.

Wounds.

1. The subject of wounds is one of great extent and importance, and has in all ages received a large share of attention from practical writers. These are common, obvious, and alarming injuries, frequently fatal, either immediately or in their remote consequences, and appeal by their very nature for instant and effectual aid. They require to be considered, first, in regard to their original condition, manner of infliction, parts implicated, extent of injury; next, in regard to their consequences, both local and constitutional, the reparative efforts of nature, and the causes of their failure, and thirdly in respect of treatment.

Kinds of Wounds.

1st. Wounds are divided into Incised, or those inflicted by cutting instruments; Punctured, or those arising from the thrust of a pointed weapon (of these stabs are an important variety); Lacerated, where the parts are torn, as by a hook dragged through them; and Contused wounds, or bruises. Of these the several characteristics are the following. In *Incised* wounds the structures are simply divided, they continue living, their relative position and internal texture is little disturbed, and if they are brought into contact and retained long enough, they will readily unite, in a healthy person, by the process termed *adhesion*, or the *adhesive inflammation*. When this is effectually accomplished the part or organ is as nearly as possible in the same condition as it was before the injury. *Punctured* wounds implicate parts at a greater or less depth, through a small aperture in the skin. The instrument insinuates itself between the textures, and displaces them by stretching, rather than divides them. Hence such wounds are often more dangerous than they seem, and are apt to be followed by severer consequences than incised wounds. *Stabs* partake of the characters of both the preceding, and are, *cæteris paribus*, more dangerous than either; they may divide parts deeply seated, as muscles or vessels, in such a way as to make it very difficult to examine the nature and extent of the injury, to clear out coagula, secure bleeding vessels, or bring divided structures into apposition. Hence the repeated hemorrhage, distending the limb with blood, and the suppuration, with matter pent up and burrowing under fasciæ, which so frequently follow this form of injury. In *Lacerated* wounds the tissues are irregularly torn, and the neighbouring parts hurtfully dragged, often at a considerable distance from the immediate seat of injury. There is comparatively little hemorrhage, the vessels being torn in a way peculiarly adapted to favour the formation of a plug of coagulum in their orifices. (See *Hæmorrhage.*) These wounds are apt to implicate nerves to an extent of several inches in consequence of the toughness of their fibrous sheath; and hence apparently the greater frequency of tetanus as a consequence of them. They are often complicated by foreign bodies, as dirt, and are much less disposed to union by the first intention than incised wounds. They generally suppurate and heal by granulation. *Contusions* are caused by the forcible compact of some blunt heavy body. The skin escapes by its toughness and elasticity, while the subcutaneous textures, vessels, nerves, or muscles, are bruised or disorganized. The effusion of blood which ensues upon them is generally from vessels of small size, and extends in the interstices of the tissues, rendering them tumid, and imparting a livid hue, which subsequently, as the blood is absorbed, passes through several well-known shades before it finally disappears. In severe contusions over the viscera, as when the wheel of a carriage passes over the abdomen, it frequently happens that the deep-seated organ is crushed or ruptured, while the skin, and even the entire thickness of the wall of the cavity, escapes with only a trifling injury. This arises from the tough and yielding nature of the parietes, as compared with the fragility of solid organs, like the liver or spleen. Contused wounds are attended with more or less concussion and deadening of the part, which may or may not recover itself. If it do not, a slough ensues, inflammation runs high, and an abscess is formed around it. Wounds very commonly are contused and lacerated at the same time. Such are gunshot wounds, which, however, from their peculiar severity and other circumstances, require to be treated of separately.

Incised. Punctured. Stabs. Wounds, lacerated. Contused.

Wounds have also to be considered with regard to their complications, such as the presence of foreign bodies, of poisons natural or morbid; the co-existence of a fracture or the penetration of any of the important cavities or organs, as those of the head, chest, or abdomen. The subject of poisoned wounds has been already discussed (See MEDICINE); the other complications will be attended to in the present article, in their appropriate places.

Treatment

Having made these brief observations on the nature and varieties of wounds in general, we must pass on to their *treatment*, referring the reader to the article just mentioned, for information concerning the nature of the vital processes consequent upon them, both in the part and in the entire system.

of incised wounds.

The surgeon's course of proceeding is usually a very plain one in cases of incised wounds. In almost every instance the divided parts recede from one another by their natural elasticity, and it will be his duty to replace and retain them in contact. It is of course absolutely requisite, before this is attempted, that any foreign particles lodged in the wound be withdrawn. It sometimes happens that this cannot be effected, and then the parts are not to be brought together. For example, in cuts by glass, much unnecessary pain and inflammation are often induced by attempts to close the

Surgery.

Treatment of incised wounds.

wound while small fragments remain buried in the flesh. These cause inevitable irritation, and prevent union. Where they cannot easily be extracted at the time, the best application is a poultice of bread and water, suppuration succeeds, and the particles easily discharge themselves. When it is determined to attempt immediate union, the edges of the wound may sometimes be brought together by attention to the posture of the part, but in general some further artificial means are required. Straps of adhesive plaster are in common use for this purpose: they are cut of a convenient width, and applied across the wound, while its edges are brought into apposition by the fingers. Care is to be taken that they are not braced too tight to allow of the tumefaction usually ensuing, and it is advisable to leave intervals between them for serum or other superfluous fluids to ooze from the wound. In wounds of particular parts, or of great extent, stitches or *sutures* are necessary. For example, in wounds of very uneven or very moveable parts, as the lips, eyelids, or ears, they are commonly required, because plaster either could not be effectually applied or would soon become displaced. The ligature usually employed consists of ordinary strong thread or silk; which is passed through the lips of the wound at opposite points and tied. The number of these corresponds with the extent of the wound. They may be from a quarter of an inch to an inch or more apart, according to circumstances. This mode of putting in stitches is styled the *interrupted suture*, in contrast with that formed by a single thread passed repeatedly. The advantages it possesses are, that it can be regulated better, and can be withdrawn in parts as occasion may demand. In all cases foreign particles present in the wound are to be withdrawn, and even coagula cleared away, as they materially interfere with the adhesive process, if they are of any size. In removing them small vessels may begin to bleed again; but these will soon cease bleeding, and, if not, they may be secured by ligature, as explained under the head of *hæmorrhage.* It may sometimes happen that structures of considerable thickness are divided, in which it is very important that the whole depth of the wound should be accurately in contact. To effect this two modifications of the common suture are occasionally used, in the first of which (the *quilled suture*) two quills are placed, one along each side of the wound, and ligatures, passed deeply through it, are tied over them, so as to press together the deeper parts. The other, commonly known as the *hare-lip suture*, consists of one or more needles passed deeply through the lips of the wound, which are then secured in contact with each other by a thread twisted repeatedly over the projecting ends of the needles. This variety of suture is highly valuable wherever an accurate and firm adjustment of the surfaces of a wound is required. In all cases in which an attempt is made to effect union by the first intention, the surgeon must adopt every measure calculated to check undue vascular action, and to prevent the occurrence of that degree of inflammation which terminates in suppuration or sloughing, since these would be entirely incompatible with the desirable end in view. The antiphlogistic regimen and treatment are to be put in practice. If the edges of the wound are tender and red, discharging a thin serous fluid, the strapping should be removed entirely or in part, the suture cut through, so as to allow the parts to recede somewhat, and a soft poultice applied over the whole. If this be not done, the inflammation will probably advance and assume an erysipelatous character, the morbid secretions from the surface of the wound will be pent up, with an aggravation of all the symptoms, and the sutures will finally become detached by ulceration. When the adhesive process fails the wound heals by granulation.

Sutures.

Interrupted suture.

Quilled suture.

Hare-lip suture.

Treatment of wounds.

Of punctured wounds.

In *punctured* wounds no apparatus is required to keep the divided parts together, and when foreign bodies have been withdrawn the efforts of the practitioner are directed almost solely, in the first instance, to the prevention or mitigation of inflammation. In addition to the general means adapted to this object, it is an essential part of the treatment to preserve complete rest in all cases where the wound is in a part liable to motion, as the muscles, or the neighbourhood of joints. The best course is to apply a moderately firm bandage to the whole limb, with the addition of a splint, if that seem necessary: over this bandage fomentation or evaporating lotion may be applied. If inflammation ensue to an alarming extent, and threaten deep suppuration, especially under fasciæ, the puncture is to be converted into an incised wound, sufficiently ample to allow free and early egress to whatever product of the morbid action may be disposed to collect there. When the puncture has penetrated a fascia, the surgeon is to be on his guard not to wait for great swelling and fluctuation ere he uses his bistoury, since all the mischief may have taken place ere it becomes evident by these signs. If pain continue unsubdued, with fever, during three days, there can rarely be any question about the propriety of resorting to the knife. It is not often that counter-openings are necessary where an early vent is afforded to the matter; but where due precautions have not been taken, and the pus has been allowed to burrow far from the seat of its first formation, they are highly useful. Of counter-openings in general, it may be said that they are of service, by giving a freer outlet to discharges, without the serious consequences of laying open the whole of an extensive cavity or sinus. They are usually to be made only where nature already points the way, by bringing the matter near the surface at a distant part, and if there is room for choice, they should occupy a depending position, so that the discharges may drain away as they are formed. Much of what we have now said is applicable to the treatment of stabs. In these injuries, the great vessels are more apt to be divided, and the wound to be distended with blood. (See *Hæmorrhage* in the present article.)

Of lacerated wounds.

Lacerated wounds frequently unite in whole or in part by the first intention if their opposite surfaces are carefully kept in contact, and general precautions used; therefore it is an axiom in surgery, at least in this country, that they are to be treated in the first instance as though they would unite, unless there be some evident reason to the contrary, such as the co-existence of severe contusion on the lacerated surface (gun-shot wounds), or the presence of much dirt in the wound that cannot be washed away. This practice is highly rational. It seems certain that there cannot be a better application to a wounded surface than that from which it has just been severed, and whatever fraction of it unites, is so much retrieved from suppuration, while, if the attempt fail, the condition of the wound is no worse than it would have been if the attempt had not been made. Of course in the early stage of lacerated wounds

Surgery.

the surgeon will look for inflammation, and be prepared to combat its excess.

Treatment of contused wounds.

Contused wounds, if uncomplicated, require very simple treatment. The blood effused distends the tissues, and as a considerable depth of substance is commonly implicated, the inflammatory engorgement following the injury is considerable, and adds greatly to the swelling and pain. It is, we suppose, on the principle of diminishing or subduing this, that the practice of bleeding the injured part with leeches is so frequently adopted; the common notion that these animals suck out the effused blood scarcely requires refutation. Warm fomentations and cold lotions are both useful remedics in contusions, but the former seem the more generally appropriate. These act by relaxing the tissues, and allowing them to yield more to the distension, the latter by diminishing the flow of blood to the part, and carrying off the excess of heat. When a large quantity of blood is collected in a cavity under the skin, as a consequence of contusion, it may frequently be absorbed, after the inflammatory action has subsided, under the use of lotions of sal-ammoniac and pressure. If it occasion obstinate inflammation, with tension of the surrounding structures, and sympathetic fever, suppuration is to be feared, and it will be the best practice to lay open the cavity and evacuate the blood. This plan usually gives instantaneous relief.

Wounds.—Thorax.

Penetrating wounds.

Penetrating wounds of the great cavities of the trunk are so important in their consequences, and so peculiar in their nature and treatment, as to require to be spoken of apart from the general subject of wounds. Their danger springs from two causes: the injury to the lining membrane, and to the vessels or vital organs contained within the cavity. Death may be immediate, or nearly so, from internal hæmorrhage, for which there is rarely any remedy at command; or it may occur at a period more or less advanced, in consequence of inflammation or its results.

Wounds of the Lungs.

Wounds of the lungs are attended with difficult and irregular breathing, hæmorrhage both into the pleural cavity and into the air passages, in different degrees according to circumstances; and with faintness, pallor, and anxiety, and a sense of suffocation. The lung collapses by the escape of air from it into the pleura, and thence externally into the cellular tissue of the body, giving rise to emphysema. If the external orifice in the parietes be large and free, the air enters the pleura from without, and is partly driven out during the expiratory movements. The collapse of the lung is commonly regarded as an unfortunate circumstance in these injuries; but it is in fact one of the most favourable description, as it greatly favours the suppression of hæmorrhage. It is well known that the lungs in a natural state are preserved in a distended condition by the pressure of the atmosphere on their bronchial surface, and that when the pressure on their exterior is allowed in any way to become equalized with that on their interior, they fall into a much smaller compass. Now the blood-vessels of the organ are adapted in abundance and capacity to its natural or distended state; and when this is diminished they have not room to transmit the blood, the size of any wound of them is materially diminished, and its sides are brought together. This is the cause of the salutary effect of collapse of the lung in arresting hæmorrhage from a wound of that viscus. When there exists a communication between the pleural cavity and the external air, either through the walls of the chest or through the lung, as the motions of respiration go on the air is pumped alternately in and out of that cavity, as it is in and out of the lung in the normal state of the parts, and as it may happen that the wound is of a *valvular* nature, so as to allow of the ingress of the air with more facility than its egress, it is possible for the air to accumulate and distend that side of the thorax unnaturally, so as to operate as a mechanical impediment to the movements of the diaphragm, and to push over the mediastinum and its contents to the opposite side, and thus in both these ways to impede the healthy action of the otherwise sound side. This state of things produces an aggravation of all those symptoms that arise from impeded respiration. The surgeon has it in his power to establish a free communication externally by making an opening between the ribs, and thus to take off any unequal pressure the air within may be exerting on the surface of the pleural cavity; and he may even succeed in some cases in pumping out a portion of that contained within by artificially reversing the valvular action at the external orifice and then stopping it by compresses or otherwise. It is almost superfluous to say, that in the wounds of the lungs attended with much hæmorrhage free and copious blood-letting must be practised, and repeated as occasion may demand. This practice is supported by many excellent reasons. It lessens the mass of circulating blood, which it is to be remembered *all* passes through the lungs in each entire circuit of the body, it enfeebles the powers of the circulation, and it tends to ward off and mitigate inflammation. The two last indications have to be pursued by a liberal administration of the emetic tartar, or digitalis; and mercury may be necessary in the sequel.

Wounds of the Heart.

Wounds of the *heart* generally prove fatal, but not instantaneously, as is commonly imagined, unless the orifice be large and inclined to gape. The fact is exceedingly remarkable, that persons who have received thrusts by knives, or other narrow instruments, especially blunt ones, often survive many days, or even several weeks. The reason of their not dying of hæmorrhage seems to be that the muscular fibres of the heart which the wound traverses are disposed in layers oblique to one another, and alter their relative positions at every pulsation of that organ, so that the wound is at once rendered more or less valvular, and only capable of giving vent to the blood within at a particular moment of each beat; and thus that this fluid has time to form a coagulum in the wound soon sufficient to prevent further hæmorrhage. And it may be for the same cause that ultimate recovery is so rare. If not worn out by the constitutional effects of the wound, and the lowering treatment it makes necessary, the movements of the sides of the wound on one another interfere with the subsequent steps of the sanative process by which the temporary coagulum becomes replaced by organized lymph.

The immediate symptoms of a wound of the heart are those of extreme prostration and deadly faintness, whether they are attended with much hæmorrhage or not. The central organ of the circulation being itself struck, that function seems for a time to be paralyzed, the beats of the heart are feeble, irregular, and faltering. This state is highly conducive to the formation of the coagulum which we have spoken of; and is not

Surgery.

Wounds of the Heart.

to be too early or too rapidly counteracted. Re-action is to be cautiously promoted, but checked by bleeding and other measures when it threatens to rise too high. Of the remaining part of the treatment we have little to say, for little is in the power of the surgeon to accomplish; he has but to watch for symptoms and too often with the almost certain dread of the failure of his most judicious endeavours.

Wounds of the Abdomen.

Wounds of the *abdominal cavity* are, if possible, even more serious than those of the lateral cavities of the thorax. Their fatality will however depend on many particular circumstances, of which the nature of this great cavity and its contained viscera affords a large variety. As the viscera are everywhere in the closest contact with the parietes and with one another in consequence of the pressure exerted by the muscular walls, and by the external atmosphere through these, it is rare to find the serous cavity laid open without the viscera participating in the injury. The liver and spleen, being usually concealed under the false ribs, generally escape direct wounds in front; but they may be struck by thrusts through the lower ribs, or through the lower part of the thoracic cavities and diaphragm. Or again, they may be crushed and lacerated by severe blows or concussions of the abdomen, such as those caused by a spent ball, by a cart passing over the trunk, or by a fall of earth; the last of which is a very common accident to our workmen engaged in excavating for railroads, canals, and other public works. Such injuries are usually fatal at once, or after a brief interval of attempted re-action, by hæmorrhage; and the practitioner is unable to render any aid beyond measures of the most general kind: he is indeed ignorant of the extent, position, and precise nature of the injury until death enables him to determine them.

Wounds of the other viscera may be produced by mere contusion, which leaves few or no traces of its effect on the walls of the cavity. Such are in most cases rupture of the hollow organs, often accompanied with an occurrence of fatal moment, viz. the escape of their contents into the peritoneal cavity. The stomach, small or large intestine, the gall-bladder, or the urinary bladder, may thus suffer, and are particularly liable to do so if distended at the time when the violence is inflicted. Their contents seem alike irritating to the serous membrane, and inevitably enkindle in it a mortal inflammation that carries off the sufferer in a few hours or days. Such inflammation is marked by more acute and exquisite pain than attends ordinary peritonitis, and its agonizing character commences suddenly, and from the very first. The abdominal viscera being surrounded by muscles which ever exert considerable pressure upon them, it follows that they are at once protruded through any aperture in the walls sufficiently ample to permit their escape. Protrusion of viscera is a common complication of abdominal wounds. The *Omentum*, from its anatomical position, is the organ most frequently displaced, and after that the small intestines, which both occupy a large space of the cavity, and are very moveable. Protruding omentum is to be returned by careful pressure, care being taken to relax the abdominal muscles by posture, and the wound being dilated, if necessary, by a bistoury. When a knuckle of gut is thrust out at the wound, it in like manner is to be returned, the same precautions being used as would be proper in a case of hernia. In particular, caution is requisite to ensure the real return of the intestine, as if small it may slip between the layers of abdominal muscles, and thus remain protruded and strangulated, although concealed from view.

Wounds of the Intestines.

The intestine, however, may be wounded as well as protruded, and then further considerations arise as regards the treatment. It is evident that it ought not to be returned with the wound open, as its contents would almost inevitably escape into the serous cavity. Whether it be returned at all, and what course should be pursued with regard to the wound in it, will depend altogether on the extent and nature of the latter. If all the coats are divided, the mucous membrane is invariably everted, owing to the laxity of its cellular connexion with the muscular, and the contraction of this upon it; if the wound be small, this eversion of the mucous lining appears in the form of a button, filling up the orifice and presenting a bar to extravasation of the contents. To this circumstance is to be assigned the infrequency of large fæculent effusions when there is really a considerable orifice in the side of the canal. In the cases of protruded and wounded intestine which we are considering, if the wound be small, that is, not involving more than a quarter of the circumference of the bowel; the mucous membrane is to be returned within the muscular tunic, and the edges of that and of the serous membrane sewed together with fine thread, the ends of which are to be cut close; after which the whole may be put back loose into the abdomen The process which now occurs, in favourable circumstances, is as follows: adhesion takes place between the affected part and the serous surface of the neighbouring organs with which it chances to be in contact, and shuts off the wound and its immediate vicinity from the general cavity of the abdomen. The ligature then occasions ulceration of the cavity, loosens and falls into the calibre of the gut, and is then carried along and expelled with the fæces, the wound being gradually united more firmly. If this process fail, it will be by the extension of peritonitis over the general surface of the membrane, the consequent failure of the healthy process of adhesion about the wound and the effusion of the fæculent matters from the intestine into the peritoneum, an event necessarily fatal.

When the intestine is wounded to an extent greater than one-third its diameter, there can be little hesitation in relinquishing all attempts to effect the cure in the way above mentioned, as being attended with too great a chance of failure, and, with failure, of certain death. The only safe treatment now will be to prevent the wounded part from re-entering the abdomen. The intestine is to be returned as far as the orifice in its coats, which are then to be stitched to the borders of the aperture in the parietes. Adhesion follows; and an artificial anus is established, which is to be treated on the same principles as in those sometimes consequent on hernia, to which subject we must refer for further information.

Gunshot Wounds.

These differ from ordinary wounds, chiefly by the severity of the contusion inflicted on the surrounding parts, leading necessarily to the death of the tissues in the track of the injury; they are usually of a very grave character, either from the extent of parts implicated, from the vital organs affected, or the danger of

Surgery. Gunshot wounds.

hæmorrhage; and they offer many minor peculiarities, arising out of the various nature of the piece or of the missile, and the circumstances under which they are usually received. The external aspect of the wound, caused by the entry of a ball, is unlike that of any other. It is round, blackened, and with inverted edges, and somewhat smaller than the missile that has passed in, owing to the partial yielding of the elastic skin before the force, and to the tumidity that quickly ensues from the engorgement of the surrounding textures. If the wound be occasioned by the exit of the ball, its edges will be most probably everted, and will appear more ragged from this circumstance. These are conditions which the cautious surgeon will not omit to notice, remembering in these and all other cases, the important rule, to gain all possible acquaintance with his patient's state, by a full examination of his person; a rule doubly necessary in all those injuries which, by their severity, tend to close up other sources of information.

Lodgment of balls.

The lodgment of balls, or any extraneous material that may have been carried before them in their course, such as buttons, coins, accoutrements, or the like, or even fragments from the mutilated bodies of comrades, forms a peculiar complication of gunshot injuries, and one demanding peculiar modes of proceeding on the part of the surgeon. Where it is possible, the finger should be employed to search for such substances, and trace the path they may have taken. Splintered fragments of bone, detached from their vascular connexions, and thereby reduced to the condition of dead extraneous substances, irritating by their deep position and sharp irregular figures, may have been driven into the surrounding soft parts, and may require immediate removal for the avoidance of the ill consequences which their delayed presence would inevitably entail. It is obvious that all such matters are to be removed, if possible, on the first inspection of the injury, and the sooner after its receipt the better; incisions are to be practised for their extraction, which may be done the more boldly, because they will tend to relieve subsequent tension and the lodgment and burrowings of pus, and may often be carried through parts that must necessarily perish by subsequent sloughing.

But it often happens that bullets cannot be traced to their real site, or this may be in the spongy texture of the bones, or in or near the cavity of a joint, buried from view, and out of the reach of any but very sweeping incisions. The most prudent course to be adopted under such circumstances will be to proceed as though they were not present. It will often happen that the progress of inflammation and its consequences will disengage the foreign body at a subsequent period, which the surgeon should be on the watch for, and prepared to accelerate as occasion may arise. And it will not unfrequently occur, especially in the interior of bones, and in such positions among the softer textures as are little exposed to movement, that smooth balls of lead, or other metal not prone to oxidize, will be gradually walled in by a firm cyst of organized lymph, and be thus prevented from irritating.

Course of balls.

The course which balls sometimes take within the body is exceedingly remarkable. "A ball will often strike the thorax or abdomen," says Dr. Hennen,* "and to an inexperienced eye, will appear to have passed directly across, or to be lodged in one of the cavities. If great difficulty in breathing, or hæmorrhage from the mouth, with sudden paleness and laborious pulse, in the one case, or deadly faintness, coldness of the extremities, and the discharge of stercoraceous matter from the wound, in the second, are not present, we shall find that perhaps the ball has coursed along under the integuments, and is marked in its progress either by what Mr. Hunter compares to a blush, or by a wheal, or dusky line, terminated by a tumor; on opening which, it will be easily extracted. In some of these long and circuitous routes of balls, where we have not this mark, a certain emphysematous crackling discovers its course and leads to its detection. The ball is, in many instances, found very close to its point of entrance, having nearly completed the circuit of the body. In a case which occurred to a friend of mine in the Mediterranean, the ball, which struck about the Pomum Adami, was found lying in the very orifice of its entrance, having gone completely round the neck, and being prevented from passing out by the elasticity and toughness of the skin, which confined it to this circular course. This circuitous route is a very frequent occurrence, particularly when balls strike the ribs, or abdominal muscles; for they are turned from the direct line by a very slight resistance indeed, although they will run along a continued surface, as the length of a bone, along a muscle or a fascia, to a very extraordinary distance at times. If there is nothing to check its course, and if its momentum is very great, it is surprising what a variety of parts may be injured by a musket ball. I have seen cases where it has traversed almost the whole extent of the body and extremities. In one instance, which occurred in a soldier, with his arm extended, in the act of endeavouring to climb up a scaling ladder, a ball, which entered about the centre of the humerus, passed along it, over the posterior part of the thorax, coursed along the abdominal muscles, dipped deep through the glutæi, and presented on the fore part of the opposite thigh, about midway down. In another, a ball, which struck the breast, lodged in the scrotum, the man standing erect in the ranks." "In six fatal cases which I very minutely examined, this occasional course on a concave surface was very visible. In two the ball passed between the lungs and pleura costalis, entering on the right of the sternum, coursing round, and passing at nearly an equal distance through the opposite side, near the spine. In one, the ball entered over, and was supposed to have passed through, the spleen. On dissection, it was found to have passed along the posterior part of the spleen, and lodged beside the spine, leaving a furrow all round from its entrance to its lodgment. In one, the ball entered exactly over the spleen, and passed round to the middle of the tenth rib of the right side, furrowing the diaphragm. In two, the balls entered close to the umbilicus, and passed out exactly opposite, beside the spine. The men were supposed to have been shot through the bowels; but it was found that the balls had passed round the abdominal parietes, run between them and the contained viscera, without opening them, and passed out. In all these cases inflammation was present to a very high degree; and, in one, gangrene was so far advanced as to render dissection extremely offensive. A further proof of the propensity of balls to take a curved direction is often seen in cases where

* *Observations on Military Surgery*, pp. 32—36.

Surgery. Gunshot wounds. Hæmorrhage.

they strike the front of the hat, and, running round, carry off the hinder tassel."

Hæmorrhage is one of the most common attendants on extensive gunshot injury, and proves almost instantly fatal in by far the greater number of those cases in which any of the larger vessels are wounded. Much, however, will depend on the size of the aperture made in the vessel, and the degree of dragging to which the artery has been subjected, for reasons which the intelligent reader will easily comprehend when he shall have perused our remarks on the general subject of hæmorrhage. In almost all cases blood continues to flow from the wound for a considerable time, and generally this blood is arterial. It never comes from the minute vessels, for these are destroyed by the injury; but unless the hæmorrhage be difficult to check by pressure, and takes place in jets, there will be no proof of a great artery being implicated. Secondary bleeding is more common in gunshot than in any other kind of wounds, on account of the certain sloughing which occurs in the track of the missile, and by which a vessel is exposed that may have been either wounded and the blood temporarily stanched, or destroyed, without being laid open. From these disastrous gushings, whether occurring unexpectedly, in the midst of symptoms otherwise favourable, or after the system has suffered severely from the inflammation, and other consequences of the wound, very many lives have been lost.

The constitutional results which ensue on wounds by gunshot are those of the severest shock, except in cases where the sufferer is armed with unusual fortitude, or has received the injury when under the excitement of conflict. Military surgeons have recorded instances of the most striking nature. "Some men will have a limb carried off, or shattered to pieces, by a cannon ball, without exhibiting the slightest symptoms of mental or corporeal agitation; nay, without being conscious of the occurrence; and when they are, they will coolly argue on the probable result of the injury."* But in general the wounded man is seized with universal tremors, deadly paleness, and cold perspirations, which are not met with of quite the same description in any other kind of injury.

Treatment of Gunshot Wounds.—What relates to the treatment applicable to foreign bodies and hæmorrhage has been already discussed. In gunshot wounds received during the movements of an army in the field, the propriety of amputation has frequently to be judged of on grounds somewhat different from those on which its determination would rest under different circumstances. The badness or deficiency of the means of transport, the distance of the hospital, the proximity of the enemy, the number of the sufferers, are all but too potent arguments, drawn from necessity, for the performance of this operation, in order to preserve life. And the nature of these injuries is in itself such as to make amputation more often necessary than in others apparently of equal extent, for the contusion and laceration of the soft parts, and their consequent death, is usually more extensive than at first appears, and great vessels will sometimes give way unexpectedly, which seemed to have escaped injury. The general accuracy of this remark will not be invalidated by the singular instances of recovery under circumstances which had appeared originally the most destitute of hope. Unfortunately, the conditions under which military surgery is practised are often such as not to allow of that accurate discrimination and calm consideration which, in civil life, will be given by the conscientious practitioner to every case in which life or limb are in jeopardy. The operations of the field are performed amid excitement, anxiety, and confusion, and it must ever happen that the result will show some to have been undertaken ill-advisedly, others to have been omitted that might have saved life, while on the other hand some cases will be found to have recovered, without having submitted to an operation which the established rules of experience would have sanctioned and even enforced.

* Hennen, *loc. citat.*, p. 31-2.

Surgery. Gunshot wounds.

Hæmorrhage.

As this is a subject of fundamental importance in Surgery, we shall offer no apology for considering it somewhat in detail in this place.

Arterial hæmorrhage.

Arterial Hæmorrhage.—The structure of the arteries is admirably contrived, not only to convey the blood propelled by the strokes of the heart into every part of the body, but to resist the violence of external injuries, and thus to screen the system from two of their most dreadful effects, hæmorrhage and gangrene. Every one moderately acquainted with the nature of severe injuries must have been struck with the immunity which the great vessels often enjoy, while surrounding muscles, fasciæ, and bones are torn or broken. And even when a large artery is lacerated, or severed across, as when an entire limb is carried away by a cannon-shot or by machinery, it is wonderful how little hemorrhage ensues, in very many instances.

The arteries consist of a thick tunic of yellow elastic fibres, arranged in a more or less circular manner, lined by a very delicate film of transparent epithelium, and invested by areolar tissue, mingled with minute nutrient vessels, the *vasa vasorum.*

This areolar or cellular tissue forms a sheath, in which the artery runs; it is extensible and elastic, composed of fibres running loosely in all directions, and thus allowing motion of the vessel which it encloses.

The yellow elastic, or proper, or middle coat of arteries, in consequence of the transverse arrangement of its fibres, will easily tear across when the vessel is stretched lengthwise, but the outer or areolar sheath, not being in the least degree brittle, will under the same circumstances be drawn out between the broken ends of the former into a tube, and on at last giving way, will form a conical canal prolonged for some distance, often for nearly an inch beyond the rupture in the middle coat, and coming to a point at its extremity. The blood has now to traverse this canal before it can gush forth externally, and for a very short time it will do so; but on its way it becomes caught in the meshes of the areolar tissue, and coagulates, forming a plug accurately fixed to the extremity of the vessel, and effectually preventing further effusion. The great artery of a limb thus plugged up we have several times seen protruding itself far out of a stump, formed by the dragging off of an arm by machinery, and pulsating strongly and visibly. The physical process on which it depends may be artificially imitated on a dead artery by forcible stretching. This is the most beautiful example of the conservative power which is provided in the construction of the living channels through which the vital fluid is destined to flow, and exhibits it in the most striking point of view. The temporary depression of

Surgery. Arterial hæmorrhage.

the heart's action, consequent on the shock, is an important aid, both to this and other processes by which hemorrhage is naturally stayed.

When an artery of moderate size is divided by a sharp instrument, there is usually more blood lost than in the lacerated wound just described. We are indebted to Dr. Jones, and since him to several other authors, for researches into the means which nature employs to restrain this hæmorrhage. "An impetuous flow of blood, a sudden and forcible retraction of the artery within its sheath, and a slight contraction of its extremity, are the immediate and almost simultaneous effects of its division. The natural impulse, however, with which the blood is driven on, in some measure counteracts the retraction, and resists the contraction of the artery. The blood is effused into the cellular substance, between the artery and its sheath, and passing through that canal of the sheath which had been formed by the retraction of the artery, flows freely externally, or is extravasated into the surrounding cellular membrane, in proportion to the open or confined state of the wound. The retracting artery leaves the internal surface of the sheath uneven, by lacerating or stretching the cellular fibres that connected them. These fibres entangle the blood as it flows, and thus the foundation is laid for the formation of a coagulum at the mouth of the artery, and which appears to be completed by the blood as it passes through this canal of the sheath, gradually adhering and coagulating around its internal surface till it completely fills it up from the circumference to the centre.*

"It appears, then," says Mr. Samuel Cooper,† "that a coagulum, which Dr. Jones calls the *external* one situated at the mouth of the artery, and within its sheath, forms the first complete obstacle to the continuance of bleeding; and though it seems externally like a continuation of the artery, yet, on slitting open this vessel, its termination can be plainly observed, with the coagulum shutting up its mouth, and contained in its sheath.

"No collateral branch being very near the impervious mouth of the artery, the blood just within it is at rest, and usually forms a slender conical coagulum, which neither fills up the canal of the artery, nor adheres to its sides, except by a small portion of the circumference of its base, near the extremity of the vessel. This coagulum is distinct from the former, and what Dr. Jones calls the *internal* one."

The processes now adverted to are attended with but a temporary suppression of the hæmorrhage; for the permanent obliteration of the vessel at the wounded point, other and less mechanical operations are demanded. In the former case there will be great danger of a recurrence of the hæmorrhage, when the extremity of the vessel and the newly formed coagulum shall slough, as they almost inevitably will do, when so much isolated from other structures; and if art do not interfere, the result will in all probability be fatal. In the latter case, the inflammation that occurs in the wound will be attended by an effusion of lymph from its entire surface, including the cut extremity of the vessel and the vasa vasorum of the sheath within which it has retracted. This lymph mingles with the coagula already mentioned, and becomes consolidated with them, sealing up the orifice and uniting it and the sheath to the surrounding structures, so that even if the general surface of the wound should assume the suppurative inflammation, the vessel will under ordinary circumstances be closed up from the external wound. Coincidently with this process, a slow contraction takes place in the coats of the vessels for some distance upwards, generally as far as the nearest branch. The coagula, too, are finally absorbed, and the extremity of the artery, being now entirely disused, becomes reduced to a firm ligamentous cord, blended with the surrounding structures.

When an artery is only partially divided, as for example, by a transverse incision through one-half of its extent, the tendency of its coats to contract will convert this slit into a gaping orifice, through which the blood gushes without the possibility of the aperture being closed by those natural processes either of temporary or permanent suppression, which have been described. Hence these wounds are of extreme danger, when the vessel implicated is considerable. If the transverse wound involve only one fourth, or less, of the circumference, there is a possibility of the coagulum formed on its exterior among the cellular texture, being sufficient to close it, and to prepare the way for the permanent closure by lymph.

Such is a brief sketch of the natural means by which hæmorrhage is capable of being arrested, and which were necessary to be comprehended before the surgical proceedings put in practice for the same object could be understood. Much more might have been added, if it had been consistent with the scope of the present article.

These means, if left to themselves, are but too often lamentably insufficient, and it becomes the surgeon's duty to step in, and, by his knowledge of what is most essential in the natural processes, to conform the circumstances of particular cases so that the desired result, the permanent obliteration of the vessel at the wounded point, may ensue. It will often happen, if the artery be small, that pressure judiciously applied will entirely command the flow of blood until a coagulum is formed, and the first steps of the adhesive process are completed, after which no other measure will be necessary beyond repose of the part, and of the system. It is constantly necessary to apply pressure in the first instance to all kinds of external hæmorrhage,—but in many instances it serves only the momentary purpose of gaining time until more effectual means can be adopted. Pressure must always be applied, if possible, to the bleeding point itself, and if the alarm of the moment would allow the by-standers to do this, even in cases of severe hæmorrhage, many lives would be rescued. But it too often happens that the sight of blood bathing the clothes about the wound prevents this obvious measure from being carried into effect, as common sense would direct. Handkerchiefs, towels, anything that is at hand is thrust over the orifice, without method or discrimination, as though to conceal the progress of the mischief from the eye were to offer an effectual check to it. It can scarcely be too strongly impressed upon persons in general, but particularly upon soldiers, and others who are liable to be called on to give instant aid in such circumstances, that very slight pressure will be sufficient to restrain the most alarming hemorrhage, if it be but applied to the right spot, that is, to the bleeding point. Pressure on the vessel above the situation of the injury, either by the finger or a

* Jones *On Hæmorrhage*, p. 53. † *Surgical Dictionary*, p. 627.

rterial æmor- age.

ring tourniquet, is the other obvious mode of temporarily arresting the flow of blood. If the tourniquet be employed, care must be taken that it be not so tight upon the limb as to cause the parts below to become turgid with blood, the consequence of which, if long continued, might be gangrene.

he liga- ure.

But where blood continues to start in jets from a wounded vessel of any size, there is but one course which will remove anxiety from the surgeon's mind, by the almost invariable certainty of its success, and that is the *ligature.* It is exceedingly remarkable that the ancients, who were acute observers of the effects of injury and disease, and ingenious in devising remedies for them, should have failed to practise this apparently obvious device; but it must be remembered that they were under the trammels of false views of the nature of the arteries, and were entirely ignorant of the circulation of the blood. The ligature appears to have been employed by Celsus, but from the fact of its having been entirely relinquished till the days of the great Paré, the surgeon of Henri Quatre, who revived it, its advantages must have been very imperfectly appreciated, and its application very limited, in the days of the Roman author.

s effects n the terial ats.

When a thread is tied round an artery, the inner and middle coats are cut through by it, while the outer coat of areolar tissue, by its toughness, resists division even by the tightest pull upon the ligature. The immediate effect is of course a puckering up of the former coats, and an apposition of their cut surfaces within the vessel, which is completely closed at the same time. Then follows the process called adhesive inflammation in the immediate situation of the ligature, the vasa vasorum pour out lymph, which envelopes the parts exposed, and becomes gradually organized and consolidated, not only around the termination of the vessel, but between the cut surfaces of the inner and middle coats within it; where a coagulum is also usually formed, extending to the nearest branch above, and more or less adherent to the lining membrane, according to the extent of the inflammation that has taken place. Meanwhile the outer coat that has been included within the loop of the ligature sloughs, gives way, and allows the thread to escape at a period varying from a week to twenty or even forty days, according to the size of the artery and other circumstances. Thus the ligature performs the part of a temporary plug, until the process of permanent obliteration is sufficiently advanced to secure the patient from a recurrence of the hæmorrhage.

ubse- ent pro- sses.

The introduction of the ligature must ever rank as one of the greatest steps in the advance of pure surgery, and the name of Paré will be remembered in connexion with this simple contrivance, long after his other claims to the gratitude of posterity shall have been forgotten. In the present day, when life is daily rescued by its employment, and the disastrous results of uncontrolled hæmorrhage are but seldom witnessed, its value can only be estimated by him who will take the trouble to acquaint himself with the condition of surgery before the days of Paré. Severe, and even trifling, operations could not be undertaken without resort to red-hot knives and other expedients, no less horrible than ineffectual, and which, while they brought the greatest discredit on surgery, most seriously restricted its usefulness. In those days disease and injury must have committed ravages among mankind which, happily for humanity, are now no longer possible in countries where surgery is practised and understood.

Arterial hæmorrhage.

The ligature, however, is not, under all circumstances, a perfect safeguard against a return of hæmorrhage. It is only an aid to certain natural processes, which may fail from many causes alien to the remedy employed. The adhesive process may be supplanted by the suppurative or the sloughing, and then of course the blood will eventually burst out. This leads us to certain precautions in the employment of the ligature, in which British Surgery may claim great merit. The ligature should not be very broad, or it cannot be tied upon the vessel in an even manner, and its office is imperfectly performed. The best thread for ordinary use is common unbleached sewing thread, or silk of corresponding thickness. It is very important that the ligature should be applied close to the healthy part of the sheath, for otherwise this structure and the artery will be apt to slough above the point of deligation. When an artery is divided in a wound it is indispensable that both orifices should be secured by the ligature, even though both do not bleed, for that further from the heart may give vent to blood carried into the vessel below the wound through collateral channels.

Failure of the reparative processes.

The consequences of failure in the process of reparation of a wounded artery are of the most serious kind, even when they do not prove immediately fatal. Secondary hæmorrhage recurs repeatedly, and debilitates the system: the blood is infiltrated extensively among the various textures of the limb, under the fasciæ, and between the muscles; and under these circumstances inflammation of a diffused kind coming on, the patient sinks unless amputation rescue him by the sacrifice of the member. When the textures of a limb are thus gorged with blood, instead of inflammation, or joined with it, there may be gangrene of the parts below, brought on by the diminished or interrupted supply of blood through the main channel, and the general engorgement,—a most unfortunate state of things, which usually proves irreparable. But another set of consequences may arise if the wound in the artery, or in the surrounding textures be small, so that the escape of blood in great quantities is hindered. A cavity, or false aneurism, may gradually be formed among the neighbouring structures by the blood rushing from the orifice of the vessel. The walls of this aneurism may consist of various textures, muscles, fasciæ, or the like, agglutinated by lymph, and its inner surface is ordinarily coated by a layer of fibrine, deposited from the fluid blood that washes its interior. The most common situation for such an aneurism to be formed is at the bend of the elbow, where the artery is occasionally punctured by an unskilful venæsector; but they may occur in almost any situation along the course of arteries of medium size. For further observations respecting them we must refer to the subject of aneurism, shortly discussed in the present article.

It is a rule of primary importance in surgery, that a wounded artery should be secured by ligature at the earliest possible period after the reception of the injury. The reasonableness of this course is too obvious to need further enforcement: the consequences of negligence or timidity in its application are sufficiently disastrous to warn every surgeon against a neglect of it. But yet the individual cases which actual practice presents are so varied in their attendant circumstances that it is not wonderful that the rule has not an unlimited applica-

Surgery. Arterial hæmorrhage.

tion, and a discriminating judgment will find abundant exercise in determining on the course to be pursued. The sudden deligation of the main artery of a limb is itself an operation which may entail the gravest consequences on the patient. Even if performed before the rush of blood has gorged the interstices of the limb, it has been known to be followed by mortification, and though this do not ensue there are other consequences scarcely less serious, from which the patient cannot be said to be safe until the ligature has separated. Now, although these untoward results are rare, compared with those in general attending the opposite course, yet they constitute a very strong objection to the employment of the ligature, wherever there is good ground to hope that milder measures may prove effectual for the repression of hæmorrhage, by the healing of the wound in the artery, without a permanent obliteration of its cavity at the point wounded. Now such hopes may often be fairly entertained in venæsection wounds, which are commonly small oblique or longitudinal punctures, are easily at the command of pressure, and are inflicted when suitable aid is at hand. In these, and similar cases, strong pressure should at once be made on the bleeding point to restrain the hæmorrhage; the whole limb from the terminal extremity should then be moderately, but uniformly compressed by a bandage, with a graduated pad on the seat of injury. After this, perfect quietude in the recumbent posture, and abstinence from every excitement should be strictly enjoined, and the progress of the case narrowly watched. Cold may be added to the above measures, if it should seem expedient, but the judicious attendant will be ready to remit this or other means, if the circulation should seem too much interfered with.

When an artery has been severed at the bottom of a deep wound, as when a sword has pierced the muscular part of the thigh, and its point touched the artery, it may be a question what course should be adopted to secure the vessel. Two might be attempted:—the one either to follow the original wound by enlarging it sufficiently to expose the bleeding vessel, the other to make an incision altogether new, as near as may be guessed to the injured point, and there taking up the artery. The former is attended with the disadvantage of an extensive division of structures, the latter with that of doubtfulness as to the position of the wound, and the necessity there might be of laying the artery extensively bare before the wound in it could be detected and secured: for to secure it above and below the wound is very important, as a safeguard against a recurrence of the hæmorrhage. Under these circumstances the best alternative is but a choice among evils. It is here that an accurate and practical acquaintance with anatomy has room to display itself, and without it the surgeon is not prepared for one of the most frightful emergencies which the practice of his profession can present. In general it will be better to endeavour to follow the original wound, even at great apparent disadvantage, especially if it continue to bleed.

But it will not unfrequently be found, even in the hands of the best surgeons, that it is utterly impracticable to secure the vessel at the point wounded, and this may arise either from the peculiar relations of the artery at that part, or from the surrounding structures having been spoiled and altered by the extravasation of blood. It will then become necessary to take up the vessel at a higher point of its course, and to trust to this measure for so far diminishing the impetus of the blood, as to allow the formation of a coagulum at the bleeding orifice.

Surgery. Secondary hæmorrhage.

Hæmorrhage recurring at an interval after the first bleeding from a wound is termed *secondary*. There are certain periods at which it is more apt to come on, such as on the re-establishment of the circulation after fainting, in that state called re-action; or subsequently, when blood becomes determined to the part by inflammatory action; or, again, when ulceration or sloughing of the wound and of the orifice of the vessel occurs, after a coagulum has formed, and the reparative process by lymph has, perhaps, advanced to some extent. At the first and second mentioned periods the treatment will be that which has been already specified, the artery must, if possible, be secured both above and below the wound; but in the latter forms there is much less chance of any attempt to do so being attended by success. Nevertheless if the wound be an open one, and the bleeding orifice in sight, an attempt may be made to pass a thread around it, by carrying it on a needle through the neighbouring textures at some little distance, so as to enclose some cellular tissue along with the vessel, which will not only enable the ligature to retain a firmer hold, but will be more sure of effectually including the entire vessel, now obscured by the changed colour and texture of the surface of the wound. If this prove unsuccessful, the only resource will be either to tie the vessel at a higher point, or to amputate the limb: of these the former is of course to be preferred. Such is the practice which it has been found advisable to pursue in cases of secondary hemorrhage from stumps which have taken on a sloughy character; and in some instances recorded by Mr. Liston, as well as in others that have come within our knowledge, it has been attended with a successful result. Before resorting to so severe a remedy, however, it is needless to say that compression and cold should be tried.

The actual and potential cautery are severe and rough instruments for the suppression of hemorrhage, and now seldom employed, but they are the surgeon's last resource in certain cases of difficulty and danger. The occasions usually demanding them are those in which it is impossible either to encircle the bleeding vessel by a ligature, or to command it by pressure; as for example in the extirpation of fungous growths from the facial bones, in operations for aneurism by anastomosis, and in general where there is an obstinate effusion of blood from a surface rather than from a few separate points. The actual cautery consists of a heated piece of metal, variously shaped to suit particular cases. Most of the instruments of this description displayed in the older works on surgery seem more to belong to farriery than to surgery, and are now deservedly discarded from use. The actual cautery, though still employed by some for the formation of issues, &c., is in by far the majority of instances superseded by the potential. Caustics are used for issues, for destroying unsound parts which have no disposition to repair themselves, such as the borders and surface of certain callous and intractable ulcers, the cysts of tumors, &c. They are likewise of advantage in the opening of certain deep-seated collections of matter, as will be afterwards alluded to.

Hæmorrhagic Temperament.—We may here briefly notice a remarkable proneness to hæmorrhage on slight injuries which manifests itself in certain persons, often

Surgery.

Hæmorrhage.

of the same family. A skin or flesh wound, or the removal of a tooth, is followed by a continued bleeding, which neither pressure on the part, ligature of particular vessels either in the wound or leading to it, or the cauterization of the bleeding surface, are able permanently to suppress. It returns after temporary restraint by any of these means, and gradually exhausts the patient. If he with difficulty recovers from two or three such wounds, the next one which he accidently receives proves fatal. There is nothing satisfactory known as to the cause of this singular defect in the natural powers of reparation ; but it has been conjectured to be due to some deficiency in the contractile power of the arteries. In a case which we had the opportunity of inspecting, we found their coats somewhat thinner than usual. The blood appears to coagulate as in other persons. In the subjects of this temperament, there is nothing by which they could be distinguished from individuals in perfect health.

Venous Hæmorrhage.

Venous Hæmorrhage.—This is distinguished from arterial hæmorrhage by the dark purple colour of the blood, and by its equable flow. It is seldom that it proves serious, since it is in general easily checked by moderate pressure on the part. Thus in the bleeding from a varicose vein, the slightest compression by a pad and bandage, joined with the horizontal position, will prevent further effusion, and in the ordinary process of venæsection. But when deeply-seated veins bleed either from a bursting of their coats, or from a wound, it is sometimes difficult to apply pressure. In violent Epistaxis it is sometimes necessary to plug tightly both the front and back apertures of the meatus, which is done by passing a double thread from the nose into the mouth, drawing a dossil then attached to it up against the orifice of the posterior nares, and afterwards tying the ends of the thread over another plug inserted into the nostril. Or again, in hæmorrhage from the tortuous prostatic plexus of veins wounded in the operation for stone in old persons, it is sometimes a matter of extreme difficulty to restrain the flow ; and nothing will succeed but firm plugging of the deeper part of the wound ; the plug being pierced by a tube for carrying off the urine from the bladder, and for counteracting its tendency to extravasate into the surrounding cellular tissue.

A rupture or wound of the principal vein of a limb is one of the most grave complications that can attend a compound fracture or other injury, and in itself is an accident of a very serious kind, often proving fatal. A sudden obstruction to the flow of blood through such a vein as the femoral is almost necessarily followed by gangrene of the limb below, although the great veins may be obstructed to a wonderful extent in a more gradual manner, without any severe consequence of this description. But the venous circulation of a limb cannot so speedily accommodate itself to a sudden change of route as the arterial, which is conducted in canals of a more extensible and elastic material, and is urged by a greater force. The wounds of veins are attended with a peculiar danger, in the suppurative inflammation that is prone to ensue within the vessel, and this danger is rather increased than diminished by placing a ligature upon them, because this acts as a source of irritation in immediate contact with them during the period that elapses ere the sloughing process allows the thread to separate. The symptoms and effects of Phlebitis belong to another part of our subject.

Surgery.

Injuries to the scalp.

Injuries to the Head.—By the term Head, in surgery, is commonly meant the cranium, as distinguished from the face. This is a part particularly exposed to injuries of various kinds, and which, from the proximity of the nervous centre, are peculiarly dangerous. The bony vault of the cranium is admirably suited to ward off the effects of violence by its subglobular figure, and by the presence and disposition of its sutures. Owing to this, wounds confined to the scalp or soft coverings of the cranium form a very large proportion of the injuries received on this portion of the body. The structure and vascular connexions of these coverings, however, render them liable to consequences which do not ensue on wounds in other situations. The occipito-frontalis muscles, with their intervening aponeurotic expansion, constitute a kind of skullcap, which is freely moveable on the bone, through the medium of an exceedingly lax and delicate areolar tissue, containing many vessels. This tissue adheres to the periosteum, which itself rests upon the bone. The vessels of the periosteum dip into the bone at innumerable points, and through the diploë inosculate with those of the dura mater, or fibrous investment of the brain, which lines the interior of the cranial cavity. Wounds of the scalp not penetrating the cranial aponeurosis are in no respect peculiar ; but if they enter the subaponeurotic tissue, the effusions consequent on them are exceedingly apt to spread mechanically underneath the aponeurosis, instead of escaping at the orifice. The result of this, when these fluids are of an irritating nature, is a rapid extension of inflammatory action over the head, which in its turn augments the amount of the offending material. This may take place in the course of a short time over the entire surface covered by the aponeurosis, and will be known by extreme tenderness, and a deep pitting on pressure, the infiltration often distending the tissue to the depth of an inch. The fluid at first deposited is serum, but if allowed to remain may quickly be exchanged for pus. The subsequent steps will, in many cases, be the formation of sloughs of the cranial aponeurosis, of the surcharged areolar tissue, and of the pericranium itself in more or less of its extent, with exfoliations of the corresponding surfaces of bone: or this frightful mischief may go so far as to reach the interior of the skull by a continuity of the inflammatory action through the bone. In this case patches of lymph may be deposited on the surface of the brain, with a fatal involvement of that organ itself in the consequences of an injury that originally may have appeared trivial.

To avoid these untoward events, everything calculated to lead the inflammation beyond the adhesive stage is to be sedulously avoided or counteracted ; all foreign particles are if possible to be at once removed, a brisk purge of calomel administered, and the patient placed upon a strict regimen. If the wound appear indisposed to unite at once, if gravel or dirt cannot be entirely removed from its surfaces, it should be covered with a mild poultice, and left open. And if there should seem to be a tendency to spreading inflammation, with accumulation of fluids, a free exit should be provided for these by free incisions through the aponeurosis. The constitutional symptoms that accompany this wide-spreading inflammation so near the central organ of the nervous system are those of inflammatory fever, and will be complicated in various degrees with others arising from the participation of the

Surgery.

Concussion of the brain.

brain, or its membranes, in the progress of the morbid action.

Concussion.—Among the injuries implicating the brain itself, the foremost demanding attention in a systematic review is *concussion*. This is familiarly known as "stunning," or "taking away the senses." The symptoms instantaneously follow the infliction of the violence, and consist in a suspension of all the mental faculties, including consciousness. On their restoration the patient cannot recall what happened when the injury was received, and is in utter ignorance of all that has occurred during the subsequent interval. The state resembles a deep sleep, from which in most cases he may be roused, but instantaneously relapses. The heart's action is greatly depressed, the pulse is small, unequal, variable; the surface of the body is cold and bedewed with perspiration. The power of voluntary motion is to a great degree lost, but this symptom is liable to vary, and the limbs are often affected with slight irregular twitchings; the irides partake of this condition, and cause the pupils to alter in size and shape. The sphincters are relaxed.

When the symptoms we have now enumerated are well marked, and continue some hours before subsiding, and especially if they show no disposition to subside, it is to be feared that more severe and disorganizing mischief is present; that the brain is lacerated, that blood is effused over its surface, or that the base of the skull is fractured. Vomiting is a most important symptom in these cases, as it mostly indicates severe injury to the brain. Mere concussion, without perceptible organic injury, is very rarely fatal, and on this account little is positively known of its nature or the manner in which it acts in producing the symptoms. But that it is not necessarily attended with rupture of vessels, or with any change in the contexture of the nervous substance visible to the naked eye, is well proved by *post mortem* observation, as well as by the speedy return of consciousness in ordinary slight cases. It is, however, easy to comprehend how a sudden jar transmitted through so soft, so delicately organized a structure as the brain should be attended with so complete and sudden an unseating of its powers. The modern researches of anatomists into minute nervous structure, if they have failed in demonstrating the manner in which it executes its wonderful functions, have at least enabled us more easily to conceive what might be the effects of a rude concussion propagated through it from its osseous case. The primitive tubules of the nerves are composed of an outer envelope of excessive tenuity, within which is a substance exceedingly prone to collect into globules, instead of forming an even stratum within the tube, as it does in a state of integrity. The slightest violence done to the tubes causes them to assume this *varicose* condition, as it has been termed, and the imagination readily conceives that it might naturally be induced by a vehement concussion in the living body, though it is a point that can hardly admit of demonstration to the senses.

The memory sometimes undergoes an extraordinary change from the effects of concussion, of which the following instance is mentioned by Sir Astley Cooper (Lectures, p. 117), as related to him by Mr. Cline. "A man was taken to Guy's, in a state of insensibility, in which condition he remained for some time, but at length recovered; and when he did so, no person in the hospital could understand his language; a milk-woman happening to go into the ward one day, heard him, and discovered that he was speaking Welsh; he told her that he knew English perfectly well before the accident, but after it all knowledge of that language was obliterated from his mind. It had been recently acquired, the impression was less strong, and consequently the more easily effaced."

Surgery.

Concussion of the brain.

"I witnessed a similar circumstance," continues Sir Astley, "in the case of a German, who was a sugar-baker in this town, and who had compression of the brain, arising not from any injury by violence, but from pressure in consequence of the formation of matter. This man could speak English extremely well before the compression; but as the compression increased from the accumulation of matter, he lost his English entirely, and I could only communicate with the medium of an interpreter. At last he lost the power of speaking, even in his native language, and he died in consequence of the accumulation of matter. It is curious to observe the gradual change which takes place in the intellectual faculties, as alterations occur in the brain; and the gradual diminution of ideas which have been more recently acquired, until at length they become totally obliterated. Old persons are observed to be fond of relating anecdotes of their youth, forgetting incidents of more recent occurrence; and the change which takes place in the intellect from injuries of the brain is very similar to the effects of age. The patient becomes, as it were, suddenly old, loses impressions of a recent date, and is sensible only of those which he has received in his earlier years. Such is the state of mind very frequently produced by compression of the brain."

Compression of the brain.

Compression.—The symptoms to which *compression* of the cerebral organ gives rise are sufficiently peculiar to make their discrimination a matter, in general, of little difficulty. They consist of stupor, more or less complete, with slow and loud breathing, slow and full pulse, and dilated pupils. The patient can be roused imperfectly by strong impressions on any of the senses, but immediately relapses into unconsciousness. There is some power of muscular motion, evinced by transient struggles, and half-uttered moanings when he is disturbed. The state altogether much resembles a deep sleep. The symptoms of compression may supervene at once, if they depend on a displacement of bone inwards in the direction of the brain, and they may be instaneously removed by its restoration to its proper place. But compression is often occasioned by an effusion of blood forming a clot either among the membranes, or within the cerebral substance; and then its symptoms approach gradually, at a distinct interval after the injury, corresponding to the slow escape of the blood from the wounded vessel. Or at a period long subsequent, when inflammation has had time to complete its effects, compression may be the result of a deposit of pus in some situation within the cranium, where injury may have been sustained.

In severe injuries to the head it very frequently happens that the indications of the nature and extent of the mischief are rendered obscure by the complication and varying intermixture of the above symptoms in the same case, and if there be no external mark sufficient to direct his judgment, the surgeon is compelled to confine himself to general measures of relief, and to await the development of more distinctive signs.

Fracture.—These vary much in themselves, and

Surgery. Fracture of the skull. Cracks or fissures.

even more in their complications and general effects in different cases. *Cracks* or *fissures* are usually extensive when they occur alone, and commonly prove fatal by the internal disorganization that accompanies them. They are occasioned by obtuse blows, as by falls from a great height; the violence must be very great in order to produce them, and this is the cause of the frequency with which they are conjoined with severe lacerations of the cerebral substance, and with large extravasations of blood. All this amount of injury frequently occurs without any thing on the surface to point out the seat or existence of such an injury, and it can only be surmised. Bleeding from the ears or nose is a common symptom of a fissure running through the base of the Skull, and it may be suspected in cases where the symptoms of laceration are present. When a fissure crosses the course of one of the venous sinuses, as of the lateral sinus, this canal may be ruptured and pour out a large quantity of blood; and a similar thing may happen when the great meningeal artery is implicated. Fissures usually take a more or less transverse direction, and run across sutures as though the whole vault were a continuous piece.

Starred fractures.

Starred fractures are the effect of great violence applied to a small part of the surface; the force is more spent upon the bone at one spot, and the internal hurt is commonly less severe. These fractures may be classed with several other varieties as local fractures. Their particular nature will differ with the kind of instrument which inflicted them, with the protective covering worn, and other circumstances too numerous to be specified. These local fractures are those so often attended with depression, and in which the aid of surgery can be most effectively employed. When the depression is obvious and the principal cause of the symptoms, the early elevation of the piece will speedily remove the most urgent of them, and frequently be the undoubted means of saving the patient's life. From the very common conjunction of the complications already spoken of, and from the further fact of even local mischief that an operation might remedy being obscured by the unbroken state of the soft coverings of the Skull, the surgeon's course is continually beset with difficulties in these unfortunate cases. In circumstances apparently hopeless it will sometimes be his duty to proceed with an explorative operation, which the result may prove to have been, in its very nature, utterly useless. But it becomes him on no occasion to refuse the possible resources of his art to a suffering fellow-creature, from a dread lest the result, if untoward, may bring discredit on himself or the operation.

With depression of bone.

If there exist a compound fracture with depression of bone or fragments driven in upon the brain, the course to be pursued is plain. The displaced pieces are to be raised, and if isolated, or nearly so, they are to be removed altogether. Loose pieces are sometimes thrust between the bone and the dura mater, and admit of removal with ordinary forceps; but in general special means have to be resorted to for the elevation of sunken bone. A lever has to be insinuated beneath them to prise them up. If there be an aperture already large enough to admit this instrument, it may be introduced, and the piece raised by making a fulcrum of the sound bone at its border; if no opening sufficiently large have been made by the injury, it is requisite that the surgeon should make one. In this consists the operation of trepanning or trephining, as it now ordinarily denominated. The trephine is a circular saw, of a size varying from that of a sixpence to that of a shilling, with a projecting centre pin, removable at pleasure. The patient being conveniently laid with his head on a firm pillow, and the integuments turned aside from over the seat of fracture, the instrument is to be placed just so far on the border of the sound bone that the centre pin may be planted upon it. It is then to be rotated backwards and forwards, by quick motions of the fore arm, until the saw has made its way into the surface of the bone. The centre-pin is now to be removed and the rest of the perforation to be completed by the saw, a probe being introduced into its track from time to time, and great care being taken that it do not penetrate beyond the inner table. A narrow lever will now be sufficient to loosen and extract it, and the subsequent steps of the operation will consist in the removal of all detached fragments, and the elevation of such as are bent in upon the brain. If any spiculæ project across the opening they are to be carefully removed, and for this and other purposes, the small saws, named after Mr. Hey, will be found of essential service. The flaps of integument have then to be brought together over the aperture, and a light compress and bandage applied. If it can be avoided, the trephine should not be applied over the course of the longitudinal sinus, or of the middle meningeal artery, as these vessels, and especially the latter, may be torn by the saw, in consequence of their lying in grooves on the inner surface of the skull.

Surgery. Trephining.

In some instances the existence of a depression of bone can be detected by the fingers, even though the integuments are themselves untorn. The discrimination, however, is liable to be obscured by effusions of blood into the sub-aponeurotic areolar tissue of the scalp, which, pitting on pressure, may even give a feeling of sunken bone, particularly if sufficient time has elapsed to allow of the walling in of the ecchymosis by lymph. But even if there be no doubt of the existence of a slight depression, this may be nothing more than an indentation of the outer table upon the diploë, while the inner, compact, and hard table of the Skull has altogether escaped injury. This, however, can only occur in adults of middle age, as the diploë does not exist either in children or in old persons. The treatment under these circumstances will be determined more by the cerebral symptoms than by the external conditions. If compression be evidently present no doubt can exist as to the propriety of the surgeon's cutting down on the suspected part to explore the bone. If he find depression he will proceed to trephine and raise the bone; if there be merely a fissure, he should yet trephine, as the inner table may be depressed though the outer is not, and especially in the hope of meeting with a clot of blood between the bone and dura mater, which may admit of extraction through his opening. Mr. Abernethy even advocated a still bolder procedure in case this external clot were not found, and the dura mater had a dark hue and bulged up into the wound: we allude to his proposal to cut into this membrane in expectation of discovering the sanguineous effusion in the arachnoid cavity. In several instances this has been actually effected, and the sufferer's life thereby saved, but it is comparatively a rare lesion, and when it does occur, the blood but too often spreads over the hemisphere, or diffuses itself at the base of the Skull, and is besides in too great quan-

Fracture of the skull.

tity to be effectually expelled through a small orifice. It need scarcely be added that this plan of puncturing the dura mater, if adopted, greatly diminishes the chance of eventual recovery from the penetrating wound which the adventurous surgeon has already made through the principal protective covering of the brain. But, if the cerebral symptoms have subsided, or are in rapid progress towards amendment, it will be prudent to abstain from making a new wound, and converting a simple fracture (if one exist) into a compound one; for, in addition to the uncertainty already mentioned as to the real existence of depression, it is abundantly proved that the brain will permanently accommodate itself to considerable depressions, even to those of a quarter of an inch, if the early dangers of inflammation be avoided. Where a slight depression of bone is permitted to remain, double attention, if possible, should be paid to the future progress of the case; and for a long period subsequently, and indeed for life, a strict abstinence from all causes of excitement should be enjoined. The lurking danger of irritation being lighted up at any after-time, by any casual excess or constitutional bent, must certainly be admitted as a strong argument against leaving a portion of bone depressed upon the brain, under circumstances at all favourable to its immediate elevation. But where the probability of permanent recovery without it is so well substantiated, the surgeon can have no right to tamper dangerously with his trephine from the dread of distant and uncertain evils.

As in the treatment of all other wounds, it becomes necessary, after the first manual adjustments are performed, to watch the progress of the local and constitutional symptoms, with a view of adapting measures of alleviation to them as they arise. Inflammation is the great and formidable enemy to be dreaded, and is to be combated by the most active remedies, as its spread among the membranes or in the cerebral substance would be attended with fatal consequences. We must confine ourselves to a very summary account of the symptoms likely to ensue on severe injuries of the brain or its covering, and of the treatment they will require, because they are in general similar to those of spontaneous disease involving the same parts, and have been considered under another head (see MEDICINE). During the first days the indications of the pulse must be accurately studied, together with the marks of febrile disturbance, and the state of the cerebral functions. Bleeding, both general and topical, will in general be found necessary and proper to be repeated. Calomel purges and enemata are to be administered, and mercurials or tartar emetic may be given so as to affect the constitution. The better acquaintance the surgeon possesses with the nature and signs of cerebral disease, and of its secondary effects on other organs, as the heart, lungs, and digestive tube, the better will he be able to adapt his remedies with prudence and vigour, as occasion may demand. For in no cases, perhaps, in the whole range of his profession, will acuteness and knowledge be more wanted to enable him to diagnosticate with judgment, than amid the ever-varying complications he will meet with in the after-treatment of severe injuries of the brain.

Consecutive effects of injury to the brain.

Patients may die during the inflammatory process immediately following the injury, and they are especially liable to do so if the cerebral substance itself have suffered laceration; for this latter hurt is necessarily followed by an increased afflux of blood to the part, and does not usually occur without a great and general commotion of the nervous matter. The lacerated part is then found pulpy, grumous, and disorganized, and the neighbouring structure discoloured with blood, both gorging its vessels and extravasated in the form of minute ecchymoses; while the membranes in the vicinity contain more blood than natural, and are more or less bathed in inflammatory exudations. If, by treatment or otherwise, the acute stage of inflammation be overpast, and the symptoms appear to have abated, or even not to have come on at all, too much confidence as to the issue must not be indulged in; for it is but too certain that the most disastrous results from these injuries are sometimes the most insidious in their mode of access. After a longer or shorter period of deceitful suspense, incoherence or sudden palsy may supervene, followed by symptoms of cerebral excitement, quickly merging in those of compression, which prove speedily fatal. On examination there is found in some part of the brain that has probably received injury when the violence was inflicted, a large collection of pus imperfectly walled in by soft vascular membrane, and the surrounding brain red and diffluent from recent inflammation,—the explanation of all which phenomena is as follows: the surrounding brain has for a time accommodated itself to the presence of a local purulent degeneration, and the activity of the first inflammation has subsided, but after the temporary lull thus caused, the pressure of the augmenting abscess has at length lighted up inflammation around, giving rise to the sudden attack and fatal consequence. It is important to note that all this train of symptoms, connected with the same condition of parts, may originate in an external injury apparently slight, and from which the patient may seem to have completely recovered. This happens, perhaps, in some instances in consequence of some predisposing cause lurking in the system previously to the injury, and which this has but served to call forth into active operation. But however that may be, the fact is one which should lead to a very guarded prognosis in all cases of injury to the head that have been attended in the first instance with evidence of cerebral disturbance.

Hernia cerebri.

Hernia Cerebri.—Hernia of the brain consists of a protrusion of a portion of the cerebral substance through the dura mater and bone, in the form of a tumor. It is remarkable that considerable masses of the brain may be destroyed or cut away, without injury to the function of the organ, or a fatal result. Hernial protrusion, therefore, is not dangerous so much by the abstraction of a part of the encephalic structure, as by the attendant evils by which the bulging of a portion of so soft an organ through a small aperture is caused and accompanied. When an aperture exists in the vault of the cranium, the brain is seen pulsating within the dura mater, and at every systole of the heart tending to rise up into the opening. When the dura mater is entire, this membrane forms a sufficient barrier against any partial expansion of the brain at the seat of an orifice in the bone; but even then, if this orifice be large, the dura mater yields somewhat, and is subjected to injurious pressure against the sharp, and often irregular, border of the bone. If the integuments be judiciously brought into contact with the fibrous covering of the brain by gentle compression, and if the reparative process advances favourably, the brain

Surgery.

Hernia cerebri.

is permanently retained within its proper limits, though it may be ever after felt through the skin, beating in unison with the heart's action. But if, from any cause, the dura mater be deficient, if it have been lacerated, or if it give way by ulceration, the brain is thrust out slowly beyond it by the gradual expansion it undergoes by the rush of blood within its vessels.

The manner in which this protrusion is effected occasions a greater change in the relative position of the cerebral matter at the part than at first sight appears. The convolutions immediately over the bulging mass are expanded, and there is, as it were, a rush of the medullary substance from all sides towards the point of eruption. By this the vessels are dragged and torn, and blood is poured into the tumor either at several small spots, or in greater quantity, so as to form a clot. When inflammation ensues in this situation, the protrusion is still further increased by the attendant engorgement of the vessels, and the same effect may be further heightened by purulent effusion. The tumor thus projected is sometimes as large as an orange.

There are instances of slight hernia cerebri having been cured, under favourable circumstances, by judicious pressure; but where the natural coverings are deficient to any great extent, the cases of it are entirely hopeless. It is impossible to return the protruded organ into its proper position; any attempt to press it back instantly occasions the symptoms of compression of the brain, and the preliminary step in the treatment must consist in shaving off the projection at the level of the dura mater. The integuments are then to be brought together over the aperture, and kept down upon it by an equable compress, for which a piece of cork or sheet lead serves as a good foundation. But in the vast majority of such cases, it will happen that this repression is sooner or later attended with bad consequences: the inflammatory process is too apt to lead to suppuration, either on the surface or in the interior of the cerebral substance, and the resulting effusions are pent up with the effects of compression. The artificial compress being removed, the protrusion recurs, the disorganizing process goes forward, and so the patient perishes.

The loss of a large mass of brain is sometimes sustained without any interruption to the function of the organ, or any ultimate impairment of its powers. So long as the rest of the viscus is uncompressed and healthy, it will, for the most part, suffice for its offices. The brain is a double organ, and one hemisphere may play the part usually performed by both. Thus injuries have been received attended with the loss of considerable portions of the convolutions, and the patients have recovered without either paralysis or intellectual defect; but, of course, the liability to inflammation and destructive changes in wounds of such great extent is too great to allow of such a result in any but very rare instances. The total insensibility of the superficial parts of the brain is strikingly shown in these cases, as well as where the surgeon has to cut away a cerebral hernia.

As the head is, philosophically speaking, an expansion and modification of certain vertebræ, and the spinal column contains parts strictly analogous to those of the cranium, it might be expected that a close relation would subsist between the injuries and diseases of these respective structures; and this is, in fact, true. The injuries of the Spine are chiefly important as they affect the delicate nervous organ enclosed with the bony column. Like the brain, the spinal marrow may suffer concussion, which will be marked by an instantaneous, but temporary, annihilation of its functions of sensation and motion, the intellect remaining clear. Again, it may undergo laceration and rupture of vessels, with their attendant symptoms of paralysis, convulsions, &c., without the existence of fracture; or, finally, the vertebræ, deeply seated, and interlocked and covered as they are with fleshy parts, may themselves sustain shocks too violent for them to withstand, and which occasion their fracture and displacement, with necessary damage to the spinal marrow.

Surgery.

Injuries of the spine.

From the depth at which these injuries are situated, their precise extent and nature are often exceedingly obscure, and can only be judged of by the symptoms referable to the marrow. Fortunately, these usually afford whatever knowledge is necessary to direct the surgeon in his measures of relief, which are much restricted by the very nature of the injury, and the parts affected by it. It is not admissible to make mechanical efforts to replace any fancied displacement, as more harm than good may result from them; and the proposal made many years since by that eminent surgeon, Mr. Cline, to trephine the vertebral laminæ, with the intention of elevating sunken fragments, after some few totally ineffectual attempts at carrying it into effect, has fallen into deserved disrepute.

Injuries of the spinal cord are distinguished from those of the brain by the occurrence of paralysis below the injured point, while the cerebral functions remain unimpaired. There will also be pain and tenderness at the seat of the hurt. The precise spot of the injury is further declared by the resulting obstruction to certain functions. Those disorganizing the cord in the lumbar or lower part of the dorsal region of the spine are attended by palsy and loss of sensation in the lower extremities, and lower part of the trunk—by paralysis of the sphincters of the anus and bladder, leading in the former case to involuntary discharge of the fæces, and in the latter to inability to void the urine. When the injury is higher in the dorsal region, the intercostal muscles are also paralyzed, and the ribs do not share in the movements of respiration. If the cervical region below the fourth vertebra be the seat of the injury, more or less of the upper extremity partakes of paralysis or anæsthesia, and the precise seat of the damage may sometimes be divined from the participation of particular nerves only in its effects. But where the injury is situate above the origin of the phrenic nerve—that is, above the third vertebra of the neck—it occasions immediate death, by putting a complete stop to respiration: the diaphragm is now paralyzed, as well as the intercostal muscles.

The result of these injuries will depend on their place and extent. They are, in general, less fatal the lower they are situated; but if the destruction of the cord and of the surrounding structures be great, recovery can scarcely be looked for. In the injury low down, the patient may slowly regain more or less of the use of his limbs, and of the power over his evacuations; but more commonly he lingers through several weeks or months in a state of helplessness, and ultimately falls a victim to the accident. The bladder has to be relieved from the first by the regular introduction of

Surgery. Injuries to the spine.

the catheter at intervals of five six or hours. If this be neglected it becomes distended with the secretion, which then escapes by the mere physical resistance of the walls of the cavity, and the tone of the organ becomes impaired or utterly ruined; and, moreover, the urine putrefies in the bladder, and the ammonia thus generated acts as a powerful irritant to the mucous membrane, which becomes inflamed, pours out blood and mucus, and may be even entirely destroyed by sloughing. These changes in the urine are promoted by a change in its chemical characters when it is secreted in the kidneys, and which seems to be a consequence of the cutting off the nervous influence from those glands. Weak injections of nitric acid and of aqueous solution of opium into the bladder have been found very efficacious remedies under these circumstances.

Whatever may be the position of the injury, it will be advisable to draw blood from the arm, or, if possible, largely from over the part itself, if the state of the pulse should be such as to indicate the presence of inordinate vascular action; and after some time has elapsed, the same end may be further answered by blisters. The alvine secretions must be solicited by purgatives, and great care must be taken that no sloughs form upon the sacrum or hips, the best preservative against which will be protective plasters, and the use of Dr. Arnott's water bed. These measures comprise almost all the aid that art can offer in these deep-seated and severe hurts: whatever degree of ulterior improvement may be looked for, must be at the hands of time and nature.

Those in whom the spinal cord is disorganized, so as to leave respiration to be conducted by the diaphragm only, do not survive more than three weeks, and usually die much within that term. That muscle, though it is the principal agent of respiration, yet is not sufficient of itself to preserve the function in integrity, while the system is burthened by the local effects of a severe injury, and when the abdominal functions are likewise so much deranged. The immediate cause of death is, in most cases, a slow asphyxia.

Fractures.

Fractures.

Fractures are important injuries on several accounts. The violence that produces them is usually great, and frequently implicates the soft parts to a serious extent: the process of reparation is slow, and if not skilfully seconded by the practitioner, will end in deformities or useless limbs. Many fractures prove fatal by the inflammation or gangrene that attends them, in consequence of the surrounding injury. The most important practical division of fractures is into the *simple* and *compound*, the latter being distinguished by the wound of the bone being continuous with a wound of the integuments. In this case the risk is far greater than in simple fracture, for reasons that will be apparent as we proceed.

Their varieties.

Fractures are also usefully distinguished as transverse, longitudinal, and comminuted, terms sufficiently explicit not to require definition. These varieties in the mechanism of the fracture depend in part on the direction in which the force has acted, partly on its degree, and the surgeon should mark them with a view to his treatment. In transverse fractures there is commonly but slight displacement, while in the oblique and comminuted forms the broken ends will overlap by the contraction of the muscles.

Causes.

Some causes predispose to fracture, such as old age, in which the bones are brittle, from a deficiency of the firm substratum of cartilage which endows the osseous tissue with its peculiar toughness and elasticity. Some diseases of the bones, such as mollities ossium, cancer, and rickets, have a similar influence. The two former of these are affections of the adult, and consist respectively in a morbid deposit of lardaceous and cancerous matter in the vascular interstices of the tissue, leading, by their pressure, to the gradual absorption of the natural structure. Under these conditions a very trivial blow, or the slightest muscular effort, will sometimes occasion a fracture; but when the bones are healthy, great violence or powerful muscular action is commonly required to produce this effect. Mechanical force may be applied in two ways; viz., either directly to the part which suffers, as when the cranium is beaten in by a hammer, or the thigh-bone crushed by a waggon wheel passing over it, in which case the soft parts commonly partake largely of its effects; or indirectly, as, for example, when the collar-bone breaks across in the centre, from a blow or fall on the shoulder.

Symptoms.

The ordinary symptoms of fracture are deformity, unnatural mobility, and crepitus, or grating of the fragments on motion. The deformity is the result of the displacement of one or both fragments, either by the force which produced the fracture, or by muscular action. The limb may be turned in a wrong direction or bent, and it is generally shortened by the overlapping or riding of the pieces. The mobility may be evident from the parts below obeying the influence of gravity, or only by the hands of the surgeon twisting the limb to endeavour to elicit crepitus. This last symptom, when clearly marked, is decisive of the presence of fracture; but when slight, it does not greatly differ from the rough grating sometimes felt when diseased ligamentous structures are rubbed against bone. With a fracture there is also usually considerable pain, more or less tumefaction, and inability on the part of the patient to move the part. When fractures are deep-seated, when they occur near joints, or when the fragments are not displaced, they are sometimes difficult to detect. In all cases the particulars of the accident should be inquired into, before an examination is instituted into the condition of the injured part; since the previous information thus acquired will give a clue to the nature of the injury, and thus save the patient from a prolonged examination.

Reparative process.

When a bone is fractured blood is of course poured out from the ruptured vessels of the bone, periosteum, and surrounding soft parts concerned in the injury; but unless a large vessel be wounded this hæmorrhage is slight. The blood diffuses itself in the cellular tissue and forms a coagulum between the broken extremities of the bone. In the course of a few days lymph is given out from the small vessels and mingled with the blood, and is gradually converted in two or three weeks into a firm reddish semi-transparent substance, termed *callus*, from the erroneous notion that it served to cement the ends like an inorganic material. This callus is full of blood-vessels, and there soon appear in it minute points of bone, which extend throughout its mass, until the whole is ossified. This process is usually completed in from one to two months. The callus invests the extremities of the bone in the form of a case,

Surgery.

Process of reparation in fractured bones.

thickest opposite the fracture, and reaching some way above and below. Within the medullary cavity (if it be a long bone) there also appears a cylindrical mass of callus, connecting the fragments. This callus is not a permanent structure; hitherto the opposed surfaces of the bone are not adherent; and this only exists while their slow union is being consolidated, through a period of from four to six months, according to various circumstances; it is then slowly absorbed. Two circumstances are necessary in the most healthy subject for the union of fractured bones:—1. A certain apposition of the fragments; 2. Rest. If a large piece of a bone be extracted, as of a rib, new bone does not grow to supply the deficiency; but if fragments overlap one another, even though they are at some little distance apart, they will often adhere through the abundance of the callus. If the constitution be debilitated, and the powers of nutrition much impaired, reparation by bone will not take place, even though the above conditions are diligently observed. Anxiety of mind and the continued influence of the depressing passions interfere in this way, as well as certain morbid states of the fluids of the body—as that causing the sea-scurvy. It is related, in the account of Lord Anson's voyage, that when a large portion of the crew was afflicted with this dreadful scourge, bones long since fractured, and which had been firmly united, loosened as completely as though they had been recently broken, and only became again knit as the constitutional taint was removed by its appropriate remedies. Cicatrized ulcers also broke out again in a corresponding manner. Bony union may also be prevented by a dead fragment of bone interposed between the broken extremities, and it may be retarded by inflammation and suppuration occurring in the textures which ought to be concerned in the deposit of the new material. It is not a little remarkable that in rickets, a disease of the nutrition of the bones, by which they are predisposed to fracture, consolidation should be perfectly effected within the ordinary time.

False joints.

When, from any of the former causes, union by bone is prevented, a *false joint* is formed. This usually consists of ligamentous matter stretching between the fragments, and allowing a certain degree of motion between them, their rough extremities being at the same time rounded off by partial absorption. It will happen, if the parts have been permitted to move on one another during the formation of this fibrous structure, that cavities of variable size will be found between its fibres, and, if large, they may perhaps be said to resemble the cavity of a natural joint, especially when they contain a viscid fluid analogous to synovia. It has been said that cartilage like the articular cartilage is sometimes generated on the exposed surfaces of the bone; and though this is not incredible, it must be very rare. The usual condition presented by bones exposed to friction on one another is that of extreme compactness and smoothness of surface, so that they have an appearance not unlike porcelain (porcelanous degeneration).

When, the natural term of union arriving, the surgeon finds the bone still loose, much may be done to promote union; for the above condition is not yet produced, and it may be possible to restore the ossifying disposition. It will be his duty to search diligently for the cause, and to remove it if it be within his reach. A nutritious diet,—a return to accustomed stimuli,—a better regulation of the secreting functions,—change of scene, may be the general measures required; and a moderate amount of continued pressure, and even of friction, may be applied to the seat of the fracture, with a view to excite the action of the vessels around it. The patient was recommended by Mr. Hunter to put the part for a short time to its natural use, as the leg to being stood upon, with the idea that this would excite in it actions appropriate to fit it for its function; but, apart from the theory, the practice was a good one, if cautiously pursued. In older cases of non-union, the object is to stimulate the parts to throw out callus; and this is to be effected only now and then, and with difficulty. A proposal of Mr. White, a surgeon of Manchester, to cut down upon the false joint and saw off a small piece from the extremities of the bone, and afterwards to replace the ends in apposition, and treat the whole as a compound fracture, has been tried on a few occasions with success; but on a far greater number it has failed: and for this reason, joined to its difficulties and severity, it has given place to a plan devised by Dr. Physick, a pupil of Hunter, which consisted in passing a seton through the fractured part, with a view of lighting up inflammation, and thus effecting the union of the bone. We extract the following account of the first case in which it was tried:—"Before passing the needle (18th Dec. 1802) I desired the assistants to make some extension of the arm, in order that the seton might be introduced as much as possible between the ends of the bone. Some lint and a pledget were applied to the orifices made by the seton-needle, and secured by a roller. The patient suffered very little pain from the operation. After a few days the inflammation (which was not greater than what is commonly excited by a similar operation through the flesh of any other part) was succeeded by a moderate suppuration. The arm was now again extended, and splints applied. The dressings were renewed daily for twelve weeks, during which time no amendment was perceived; but soon afterwards, the bending of the arm at the fracture was observed not to be so easy as it had been, and the patient complained of much more pain than usual whenever an attempt was made to bend it at that place. From this time the formation of the new bony union went on rapidly; and on the 4th of May, 1803, was so perfectly completed, that the patient could move his arm in all directions as well as before the accident happened. The seton was now removed, and the small sores occasioned by it healed up entirely in a few days. On the 28th of May, 1803, he was discharged from the hospital perfectly well; and he has since repeatedly told me his arm is as strong as ever it was." Since this case was published the operation has been successfully performed in many instances, and though it has sometimes failed, it must be regarded as a considerable improvement on the means of relief previously at our disposal.

Surgery.

Treatment of non-union of fractures.

Treatment of fractures.

In fractures which compel the patient to observe the recumbent posture for a considerable time, as in those of the thigh and leg, it is of importance that the bed should be so firm as not to yield much to his continued pressure, because the sinking of his body will be very apt to displace the upper fragment of bone. A board should be placed under all, and the feather-bed under the mattress. It will be also convenient if the central part of the mattress be made of a separate piece, so that it can be withdrawn for his evacuations without disturbance to his posture. A draw-sheet will

Surgery. Fractures. Treatment.

also be useful, for a similar reason. The first thing to be done with the fractured limb itself is to bring it into as natural a position as possible. This is to be effected partly by a change of posture,—by relaxing those muscles the contraction of which has been the chief cause of the displacement. The surgeon cannot efficiently perform this essential part of his duty without a competent knowledge of the situation and actions of the muscles on the skeleton, and of the mechanism of the particular fracture he may be treating. If the limb be not laid in the posture which on the whole is least apt to disturb the bones when set, the after part of the cure is likely to be retarded by the ends rising out of their place, or by the unconscious efforts of the patient to alter the attitude given him by the surgeon. If the broken ends overlap, the limb is then to be lengthened or *extended.* The upper part is fixed by an assistant, while the surgeon grasps the lower with his hands, and pulls upon it until the fragments are in the same line. He will be materially assisted in this by having previously relaxed the muscles: this is what is meant by *setting.* The bone has now to be retained in position by suitable apparatus. These ordinarily consist of splints, compresses, bandages, and a variety of mechanical contrivances adapted to particular fractures, all of which may be included under one or other of the above-mentioned heads. The common splint is a strip of wood glued to stout leather, and then split up, so as readily to conform itself to the rounded surface of a limb. Splints are also made of other resisting materials, such as sheet-iron: a soft pad is always interposed between them and the skin, which may be covered in most instances with a bandage. Compresses are used to determine pressure to particular spots, to distribute it over the irregularities of a limb, and to retain the soft parts in a compact state around the bone. The splints are to be fixed by tapes, tied moderately tight. An important practical rule must be observed in the first application of a retentive apparatus to a fractured bone,—viz., to observe the state of tumefaction, which invariably follows a fracture when complicated with much injury to the soft parts. If this have not already taken place the bandages must not be drawn tight; they had better even not be applied at all until the swelling arises, since they are liable to constrict the limb when it swells, and to prevent the return of blood, causing vesications, and even gangrene.

Some surgeons, after the tumefaction has a little subsided, apply a starch or *dextrine* bandage, which, on hardening, forms a firm and unyielding case accurately fitted to the limb, and incapable of changing its shape. This is worn during the whole progress of the cure. Others employ it only in the latter stage of the reparative process, finding it inconvenient to be unable to inspect the state of the limb from time to time. This practice, if employed from the first, has the disadvantage of encasing the limb in a composition that may be moulded to any bad position that the bones may take ere it be dry; and that cannot be removed without considerable delay and difficulty in case of any untoward circumstance arising that may require a change of the dressings. In this country it has been allowed to fall very generally into disuse, although but recently introduced; it is, however, a convenient splint to enable the patient to rise from bed and take moderate exercise after the third week, and for this purpose safer and less cumbrous than all others. During the cure of a fractured bone, and especially during the first fortnight, the constant attention of the surgeon is demanded to subdue inflammation and to prevent displacement, and this can be best accomplished where the apparatus is easy of removal.

Compound fractures.

The nature of the injury in *compound fractures* renders necessary some important differences in the treatment. The bone may ride up through a hole in the integuments made by its sharp extremity, and it may be requisite to saw off a portion, or to enlarge the wound, in order to restore it to its place. It may be broken into numerous fragments by direct violence, as by a musket-ball; and some of these may be loose in the wound or driven among the muscles. All such should be extracted, if possible, at the earliest moment, since, if allowed to remain, they can only act as foreign bodies and excite inflammation, leading to suppuration and sinuses, and preventing union. There may be extensive destruction of the skin and other soft textures; or the main artery of the limb may be torn through; or a joint may be implicated in the wound, sometimes by the fracture running into it. All of these circumstances form complications of the gravest kind; and any two of them occurring together, particularly in the lower extremity, are usually sufficient to make amputation necessary. The surgeon has to consider—first, whether the risk of life will be materially diminished by this severe alternative; and, secondly, if life be secure, whether the limb can recover so as to be of use to the patient: he looks not only to the immediate, but to the ultimate, result of the case; and has often to determine and act decisively under circumstances of peculiar doubt and responsibility. If the main artery be wounded he knows the difficulty of securing it, and remembers, that though in a sound limb the circulation might be diverted into collateral channels, yet that here the general tumefaction and inflammation of the tissues will seriously interfere with this salutary process; and that if immediate sphacelus is escaped, yet the tedious and wearing course of a large suppurating surface, and the reparative process itself, stand but a poor chance of being adequately supported by a vascular system locally debilitated. If the skin be bruised or lacerated, so that a great portion of its circuit round the limb must perish, recovery would still offer too poor a substitute for the healthy member to make it worth the danger incurred in the attempt to save it. If a joint be entered, the constitutional disturbance will be far greater; and if the patient survive, the articulation will be useless. But death follows, sooner or later, in so many cases of compound fracture into the larger joints of the lower limbs, that it is a general rule in surgery to amputate in such cases. At all times the surgeon's decision on this all-important question must have a regard to the age, constitution, and mode of life of the sufferer,—the young and healthy having far greater resources against such a strait than the old in years or constitution. The remedial means at hand have also to be considered; as an amputation may reduce a wound, certain to be protracted and complicated in its course, into one requiring only simple measures for its speedy cure. Thus, in military operations in the field, amputations are necessary in many cases which might have recovered without them in the more secure and tranquil asylum of a civil hospital.

Question of amputation

The local treatment of compound fractures comprises

Surgery. Treatment of compound fractures.

the reduction of the bone to its place, and the retaining it there, as well as the dressing of the wound of the soft parts. There is more swelling than in simple fracture, therefore the retentive apparatus should be less firmly applied and the limb attentively watched, in case the bandages should require to be loosened. Where the wound is small, an endeavour should be made to unite it by the first intention, which, if it succeeds, reduces the injury to a simple fracture, and greatly promotes the rapidity of the cure. If the wound be a contused one, and adhesion is hopeless, simple dressing should be used, and the suppurative stage encouraged by every means in our power. Great care is requisite to prevent the pus formed from burying itself in the recesses of the wound and lodging there, as this untoward circumstance enlarges the sphere of the morbid action and leads to death of the exposed surfaces of the bone, as well as to other evils, which it is the duty of the surgeon to foresee and counteract. Sometimes incisions must be made to give vent to matter burrowing in situations remote from the outward orifice already existing; but these may in general be avoided by judicious pressure, by compresses, and skilful bandaging. Bleeding from the arm is required in young and robust subjects, when the inflammation runs high; but the lancet must be employed with the caution which the certainty of the approaching drafts on the powers of the system ought to inspire. The antiphlogistic treatment is to be pursued until suppuration is established; opium, given in moderation, is useful to quiet irritation and procure sleep.

Reparative process in compound fractures.

The reparative process, after a compound fracture with suppuration, differs slightly from that we have above described, as occurring in simple fracture: it is rather allied to the granulating than the adhesive process, in wounds of the soft textures. Callus is thrown out in the neighbourhood of the suppurating surface of the wound, and gradually increases so as to fill up the interval between the bones, and obliterate the cavity of the wound. While this is slowly proceeding, the callus first formed is undergoing ossification. If portions of the fractured extremities perish, they are thrown off by a tedious process of absorption of the surface of the living parts next to them; and the wound does not finally close up until these *sequestra* are discharged, which is often many months in being effected.

Particular fractures.

We shall now offer a few observations on some of the principal fractures which call for the aid of the surgeon, rather with the view of illustrating our previous general remarks, than of giving a complete account of the subject, to do which would carry us far beyond our limits.

Fractures of the ribs.

The fractures of the bones, forming the great cavities of the body, may be classed together as being chiefly important, from the participation of the vital organs they enclose in the consequences of the injury. Fractures of the head and spine have been considered elsewhere, and we may now advert to those of the *Ribs*. These bones being much exposed to violence, and of a slender structure, are very liable to fracture, which usually occurs near their greatest convexity, and in several contiguous ones at the same time. The attachment of the ribs to the vertebræ and sternum by ligaments, and to one another by the intercostal muscles, does not allow their broken ends to become displaced, except inwards or outwards; and thus often renders a simple fracture difficult of detection, especially if it exists only in a single bone. Crepitus may be felt when the patient breathes or coughs, if the hand be laid on the bone near the fracture; or if this symptom be wanting, he will feel pain when the rib is pressed at a distance from the part hurt. In ordinary cases, all that is necessary is to restrain the movements of the ribs by a moderately tight girth of flannel, which, by its elasticity, accommodates itself well to them, and leaves respiration to be performed chiefly by the diaphragm. This bandage is worn for a fortnight or three weeks, after which the provisional callus is sufficient to prevent movement of the fragments on one another.

When the fracture is caused by direct violence, the ribs may be beaten in upon the lung and wound it, thus forming a severe complication. The symptoms of this will be expectoration of blood in small quantity, with constantly recurring cough, attended with great pain. The distress and anxiety of countenance will be greater, and there will probably be an escape of air from the lung into the serous cavity of the thorax, and thence into the cellular membrane of the body through the seat of fracture. This inflation will be recognized by a diffused puffy painless swelling, crackling under the fingers as the air is pressed from one place to another. This emphysema of the thoracic walls is of no consequence in itself, but only as an indication of the injury to the lung. In slight cases the wound in this viscus is almost instantly closed, so that but little air enters the pleura; but when it remains open sufficiently long the lung collapses, and the serous cavity is filled with air. Thus one-half of the respiratory apparatus is rendered useless, and the motions of the diaphragm are greatly impeded by the accumulation of air. The wound being open, the air is driven by the expiratory movements of the walls of the chest into the cellular tissue outside the ribs, and thence it may permeate the whole of the body, if the pumping action of the thorax continues long enough. A patient, under these circumstances, is in imminent peril of death from suffocation: he pants for breath like an asthmatic, his inspirations being rendered irregular and snatching by the pain. His countenance is livid, and he cannot lie down; he is agonized by incessant cough. The treatment, under these circumstances, has usually consisted in puncturing the wall of the chest, with a view of letting out the accumulated air, and allowing the diaphragm to move equably—a proceeding that has sometimes been attended by relief, but has more often proved ineffectual; for unless the air could be forcibly extracted the lung would not expand, nor the diaphragm be relieved. Punctures may be made in the external parts to diminish tension, and allow them to receive more air from within the pleura; but general bleeding is the most important remedy. This not only diminishes the chance of inflammation in the wound, but, what for the moment is even more important, it reduces the volume of the circulating fluid in proportion to the reduced size of the respiratory organ. In all cases of fractured ribs, where the lung appears overloaded, this is the most valuable measure of relief to which we can have recourse. The air is subsequently absorbed into the blood-vessels, and the wounded lung expands: opiates are to be cautiously given to diminish the distressing cough.

In compound fracture of the ribs, the air enters the pleura from without, and the lung collapses. If it be

Compound fracture of the ribs.

wounded, this collapse often becomes a salutary circumstance, preventing hæmorrhage by closing up the wound; but bleeding, in such cases, is apt to occur from the intercostal artery, which takes a course under the rib. It may bleed inwardly, which will be known by the faintness induced. If possible, the artery is to be secured by a ligature, which may be passed round it by a curved needle. If the external wound be small, it may be possible to introduce a tube, and suck out some of the air from the pleura, which will cause the lung to dilate; after which, strapping is to be applied to draw the lips of the orifice together. But more commonly, in these accidents, several ribs are broken together, or it is a gun-shot wound, and such a proceeding would be impracticable. If a detached fragment of bone, or a ball, have been driven in, it may lodge in the lung, or may gravitate to the lowest part of the pleural sac: it will then usually be hopeless to endeavour to extract it, and more mischief than good would result from such efforts. A bullet may be surrounded with lymph, and be permanently fixed, if the patient is kept in one posture sufficiently long to allow of the consolidation of the new material. Penetrating wounds of the thorax, without fracture, are attended with many similar symptoms, and require very similar treatment.

Fractures of the sternum.

Fractures of the *Sternum*, or breast-bone, are rare: they are always occasioned by direct violence, and are commonly attended with a depression at the injured part. The general symptoms, and the treatment, do not differ in any important respect from those of fractured ribs.

Of the Pelvis

The strong arch of the *Pelvic* bones is never broken without extreme violence, which generally inflicts serious injury on the important viscera within: the colon, or bladder, or urethra, may be ruptured, or the great vessels torn. These accidents are often caused by a fall of earth in embankments. The rupture of one of the hollow viscera is attended with an extravasation of their contents into the peritoneum, which almost invariably proves fatal in a few hours; or the patient may survive a few days, and die from the inflammatory results of the injury. When the fracture runs across the arch of the pubes, the urethra may be lacerated across—an accident that will be known by bleeding from the canal, and by great pain, and perhaps swelling, in the perinæum. The patient cannot evacuate his urine; it extravasates into the cellular membrane of that region, and around the bladder in the track of the fracture. When this occurs abscesses form, and ossific union is prevented: there is retention of urine and distension of the bladder, which, if not relieved, becomes inflamed and sloughs, and the patient perishes. In this case it is the surgeon's first duty to endeavour, with great care, to pass a catheter past the rupture into the bladder. If he succeed in this before extravasation has occurred, the urine will probably flow past the fracture without insinuating itself between the fragments; but if there be reason to apprehend a dispersion of this irritating fluid beyond the canal, a free incision should be made into the membranous portion of the urethra (which is always the part torn), by cutting on the catheter. This effectually prevents further extravasation among the tissues, by affording it a free and direct exit. The treatment of the fractured bones themselves is confined within very narrow limits, —rest in the horizontal posture, and a simple bandage encircling the pelvis to preserve immobility. The bowels are to be kept moderately free. The consequences, on a recovery, will very probably be some deformity and awkwardness in gait, depending on the particular nature of the fracture and the attendant displacement. Fractures of the projecting parts of the pelvis, such as the wing of the ilium, are less severe in their results, being produced by a less amount of force, and often unaccompanied by serious disorder of the contained organs. The detached fragment may be moved, and crepitus felt: it should be retained in place by bandages, as accurately as circumstances will permit.

Fractures.

Fractures of the thigh.

Fractures of the *Thigh-bone* present great varieties, according to their situation and other circumstances. In fracture of the shaft, which usually happens by force directly applied, or by a fall from a height on the feet, the upper fragment is drawn forwards by the action of the muscles fixed to the lesser trochanter, while the lower is dragged upwards behind it by the hamstrings, so as to shorten the limb by two or more inches. The direction of the fracture is often oblique, and favours this displacement: when the patient lies down, the foot falls outwards. In healthy persons this fracture, if simple, does well, uniting in the usual time; but the muscles tending to produce overlapping of the ends of the bone are very powerful, and some degree of shortening is not an unfrequent consequence, in spite of care and skill on the part of the practitioner. Pott inculcated a flexed posture of the thigh and leg, with splints from the hip to the knee, the patient reclining on the injured side: and, doubtless, many limbs thus treated have been preserved straight, and of their proper length. But continual care is required to effect this, and in many instances a repeated re-adjustment of the splints is made necessary, by the movements of the body affecting the upper fragment: the patient unconsciously leans over on his back, while the limb is bound down on its side. Thus the union is apt to take place with the foot turned outwards in an ungainly manner, offering an impediment in walking. A double inclined plane, with splints for the thigh, is a better apparatus: its inconvenience lies in the tendency of the trunk to slip off it, and carry the upper fragment inwards. But, perhaps, the best splint for this fracture is that contrived by Desault, and now known by his name. It is placed on the outer side of the limb, and extends from the arm-pit to below the heel: it is first fixed by a band passed between the thigh and scrotum, and fastened to the splint above, and which may then be carried round the trunk. The limb is then extended, and the foot bound down to the lower end: the limb is then bandaged to the intermediate part of the splint. By this apparatus the thigh is kept extended, and the upper fragment, with the trunk, kept in a line with the lower. The inclined plane, however, is to be preferred in compound fractures, as being more calculated to allow of frequent change of dressings.

Fractures of the upper extremity of the femur are of two kinds, those occurring within the capsule, and those occurring on its exterior. The former happen to persons, especially women, advanced in years, from slight falls on the foot, sometimes from falls on the hip itself. This part of the bone is not only atrophied in aged persons, but also rendered more horizontal in its direction, and thus is less able to resist forces applied to it through the shaft. The latter are also more fre-

Surgery. Fractures of the thigh-bone.

quently met with in old persons, though they may happen to those of almost any age: they are always occasioned by falls on the hip, or other direct violence. In fracture *within the capsule*, the limb is usually shortened by from half an inch to two inches, and the limb is everted; though sometimes, when the fragments are interlocked, neither of these symptoms is present, and the limb may in rare instances be even inverted. Crepitus is not felt until the limb is drawn down to its natural length and rotated, for without this precaution the fractured surfaces are not in contact. In this fracture it is impossible that the provisional callus should form, and, moreover, the detached head of the bone is nourished only by a slender anastomosing vessel, running to it in the round ligament that attaches it to the acetabulum, and is thus incapable of undergoing osseous union, except in very rare cases. The neck of the bone becomes in great part removed by absorption, and the surfaces adapt themselves to one another: the remnant of the neck plays in a socket, formed partly by a condensation and scooping of the cancellated structure of the head. The upper part of the capsule, now receiving the pressure which the acetabulum did before, becomes greatly thickened and almost cartilaginous. A very useful limb results, though necessarily attended with deformity. The conditions now related show the wisdom of Sir A. Cooper's advice, not to bind up this fracture, and confine the patient for months, in the hope of bony union occurring: such a course wears out her remaining strength. She should be allowed to assume an easy posture in bed, and begin to move about with crutches in the third week. In fracture outside the capsule, either at the base of the neck or through the trochanters, there is not so much shortening and eversion, and crepitus is felt much more easily. There is more pain and swelling, callus is thrown out in abundance, and ossific union occurs. In this fracture, therefore, the means already described for keeping the fragments in contact are to be employed. It sometimes happens that the limb is inverted instead of being everted, which is caused by the peculiar obliquity of the line of fracture, the chief rotators outwards remaining with the upper fragment, and the insertion of the anterior fibres of the two smaller glutei (which turn the thigh inwards) with the lower. There is generally deformity after this accident, on account of the impossibility of adapting any retentive apparatus on the parts: it frequently proves fatal in old persons.

Fracture of the lower extremity of the femur into the knee-joint is an accident of great severity. The blood extravasates into the joint, the inflammation is great, and requires the most active antiphlogistic treatment to prevent disorganization, or at least anchylosis of the joint. It is difficult under these circumstances to apply splints, and the subsequent deformity is sometimes considerable. The outer condyle is apt to be united in a higher position than natural, thus giving an obliquity to the articular surface, which throws an undue strain upon the internal lateral ligament, and leaves the joint weak ever afterwards. Passive motion must be used towards the fourth week, to prevent false anchylosis.

Of the Patella

Fractures of the *Patella* are of two kinds: the most common is that caused by the powerful action of the extensor muscles. The patient slipping backwards makes a sudden effort to save himself, and snaps the bone across. The fracture is transverse, and the upper fragment is drawn two or three inches from the lower, which is retained in its place by the ligamentum patellæ passing to the tubercle of the tibia. Blood is, of course, effused into the joint, which throws out an increased quantity of synovial fluid. There is a wide gap between the fragments, into which the fingers sink. There is, of course, total inability to extend the leg, and great pain. The limb is to be laid in an extended posture, with the heel raised on an inclined plane to relax the rectus muscle of the thigh, the only extensor coming from the pelvis. Care must be taken not to bandage the knee too tightly before tumefaction arises: leeches may be applied if the inflammation seem to require it. When this has diminished, or at first if it be only slight, a compress may be placed above the upper fragment, and this made to descend towards the lower by proper turns of a roller, or an apparatus devised by Mr. Lonsdale may be used. This consists of a steel ring padded, and with a cushion which is to be fixed above the upper fragment by a screw: a circular bandage is then passed round the knee, and to this the ring and cushion are drawn by straps, thus preventing all constriction upon the limb. In about a month passive motion must be commenced, to prevent adhesion to the condyles of the femur. The union is always by ligamentous substance, which usually suffers some elongation by use, but without impairment of the movements of the limb. The other variety happens from a direct blow on the bone, as by falling on the knee from a height, or on the edge of a stair: this is the *starred* fracture. The bone is split up into many pieces, the fragments are but little separated, the parts are much bruised, there is great ecchymosis, pain, and tumefaction. The subsequent inflammation runs higher, and demands more vigorous treatment. The retentive apparatus cannot be applied so soon; but when the swelling is in course of subsidence, the fragments may be brought more effectually together, and bony union be expected. After fractures of the patella, a knee-cap should be worn for some months, as a protection to the joint and a security against a recurrence of the accident. Compound fracture of the patella is a case usually calling for amputation.

Fractures of the leg.

Fractures of the bones of the *Leg* are very common from falls and direct violence. When the tibia is broken, the fibula generally gives way too, but often at either a higher or lower point. The fibula, however, frequently snaps two or three inches above the ankle, by sudden twists of that joint, without the tibia suffering, except at the summit of its malleolus, by a drag on the internal lateral ligament. In fractures of the leg there is danger of the shin protruding through the integuments, especially if it present a sharp splintered extremity. The lower fragment is drawn up behind it by the flexor muscles. The limb may be bent and laid on the side, resting upon a splint with a foot-piece. It is then to be extended by the foot, the knee being fixed by an assistant; and when the bones are reduced to their positions, the foot is to be bound down to the foot-piece. Another splint is now to be laid along the limb, and should extend below the ankle, and the whole tied with tapes and confined on an ample pillow. The tendency of the toes to drop outwards should be counteracted by suitable pads, and the patient made to keep his hip well under him. Sometimes a narrow splint may be advantageously applied

Fractures of the leg.

along the shin, but with caution lest the skin be made to slough by being pressed against the bone; or the patient may be placed on his back, with the limb elevated on a double inclined plane, the splints being applied on the sides, and the foot supported by a foot-board, which may be adapted to draw downwards, and so extend the limb. The heel often sloughs in this apparatus, unless a nest be hollowed out for its reception. The inclined plane, or some one of its numerous modifications, is particularly adapted to compound fractures of the leg, as the side splints admit of such ready removal and replacement in the daily dressings; and the front being uncovered, lotions or poultices may be employed without inconvenience. These fractures require no special remarks. In the fracture of the fibula above the outer malleolus, with laceration of the internal malleolus or ligament, commonly called Pott's Fracture, a restoration of the fragments to their proper place is often difficult. The lower fragment is sunk in towards the tibia by the outward dislocation of the foot, to which it remains attached by the external ligaments. The foot is rotated upon its long axis, the outer edge being directed upwards. On returning it to its natural position, and drawing it forcibly inwards, the outer malleolus is acted on by the fulcrum of the lower end of the tibia, and thereby lifted out of its hollow. This was clearly pointed out by Dupuytren, who used a peculiar splint for retaining it in place. This consists of a straight splint, to be laid on the tibial side of the leg, and to project beyond the foot: its pad is to be gradually thicker as it approaches the ankle, and there to cease altogether; so that there remains a wide interval between the splint and the foot. The splint being fixed by bandages as far down as the ankle, the foot is to be drawn and fixed inwards to the splint, beyond the line of the leg. This ingenious contrivance is to be retained for three weeks, when, the provisional callus being formed, it may be removed, and a plain roller substituted: any inversion of the foot may be easily remedied, by applying the splint for a day, on the outside of the limb. The importance of lifting out the sunken end of the fibula is seen in cases where it has not been effected. The interval between the malleoli is wide, and the joint loose. The reparation also about the inner malleolus has not proceeded favourably, and that region of the joint continues weak, and unable to sustain the increased stress that is laid upon it.

Fractures of the foot.

Fractures of the *foot* being usually the consequence of direct force applied to the part, are apt to be attended with such severe injury to the soft parts as to render amputation necessary. In such cases the surgeon should remember that the more he can save the better, consistently with his duty of making a serviceable stump. The line of separation may be that between the metatarsal and tarsal bones, or that in front of the os calcis and astragalus, as circumstances may determine; or the bones may be sawn across in the interval. If amputation be not deemed necessary, a splint on the sole is requisite. If inflammation run high, it is to be combated by leeches, &c., and matter is to be evacuated early, by incisions through the plantar aponeurosis.

Fractures of the clavicle.

The *clavicle* is broken very frequently, being a slender bone, and the structure that ordinarily receives the principal force of blows inflicted on the shoulder. If a person is pitched upon this part the clavicle suffers. It may be dislocated; but it is usually fractured about its middle. It is also exposed, by its superficial situation, to the effects of immediate violence. The injury is easy of detection: the outer fragment is pulled downwards by the weight of the arm, and the inner remains stationary between the sterno-mastoid and great pectoral muscles. It is easy to restore the position of the fragments, but difficult to retain them during the time necessary for the union; hence frequent deformity. The apparatus devised by Desault is very useful. When this is not at hand, a pad should be fixed in the axilla by a handkerchief passing round the neck; the shoulder should then be drawn upwards and backwards, and fixed by a figure-of-8 bandage crossed between the scapulæ; the elbow is afterwards to be brought over the chest, and supported high in a sling. Three handkerchiefs may be made to answer the same purpose. The bandages will have to be replaced after a time. No pad is to be applied to the fractured part.

Of the acromion process.

The *acromion* process of the scapula may be struck off by a fall on the tip of the shoulder; the deltoid muscle instantly draws it down, thereby removing the prominence of the shoulder. On elevating the arm the fragment is brought to its proper level; and on rubbing it against the opposite surface, crepitus is felt. This accident is to be distinguished from dislocation of the humerus. The cure requires attention on the part of the surgeon. If the piece unite at an angle, it encroaches on the arch under which the head of the humerus moves, and restricts the movements of the arm; or it may unite by ligament only. The patient should keep his bed, and the arm be separated from the side to relax the deltoid; if he must be up, a graduated pad must be interposed between the arm and side so as to effect the same object, and the elbow must be raised in a sling.

Of the body of the scapula.

Fracture of the body of the *scapula* may occur in almost any direction, and is the result of immediate violence. The displacement will vary with the line of injury, and will be little under the surgeon's control. He will endeavour, by varying the position of the arm, to bring the parts into as close apposition as he can; and will then pass broad bandages to bind the scapula to the thorax. If there be comminution of the bone, the displacement is likely to be considerable and to interfere permanently with the free motions of the part. Fractures of the coracoid process are rare, and are to be recognized by pressure on the part. The neck of the scapula is occasionally broken; the glenoid cavity then drops with the arm, and the shoulder has a sunken flattened appearance below the acromion. It may be taken for dislocation of the humerus into the axilla, or for fracture of the neck of that bone. From the former it is easily distinguished; and if the accident be recent, a careful examination will commonly enable the practitioner to discriminate it from the other. When a portion of the border of the glenoid cavity is chipped off the nature of the injury remains obscure.

Of the humerus.

The *humerus* may be fractured in the shaft or at either extremity: the fracture of the shaft is known at once by the unnatural mobility, the deformity, and crepitus. This is amongst the simplest of all fractures in its nature and treatment. Splints are placed on three or four sides of the arm, from the shoulder to the elbow, after the fragments are brought into a line: the elbow is allowed to hang, and the wrist supported in a sling. Fracture of the upper extremity may occur either above

Surgery.

Fractures of the humerus.

or below the tuberosities which receive the insertion of the scapular muscles. In the former case, which is rare, the displacement is slight, but the arm drops a little inwards; in the latter case, the shaft of the bone is drawn inwards by the powerful action of the great pectoral muscle and of the latissimus dorsi. Crepitus is felt when the bone is pushed outwards and raised. The arm is to be separated from the side by a thick pad; splints are to be applied, and the arm supported by a sling.

The lower end of the humerus may be broken in several directions, which it is important to distinguish. There may be an oblique fracture above the articular eminences; the deformity will be somewhat like the dislocation of the fore arm backwards, the radius and ulna, with the lower fragment, being drawn up behind the other by the triceps extensor cubiti. There is great tumidity in front by the projection of the brachialis muscle on the upper fragment. The fragments are generally replaced without difficulty; but to retain them in position is not easy, on account of the swelling that commonly accompanies the injury and the small purchase that can be obtained upon the lower fragment. The limb is to be laid upon a pillow in as good a posture as possible, and covered with a light roller and fomentation. When the inflammatory swelling has in some measure subsided, a pasteboard case may be adjusted to the elbow, from the middle of the arm to the middle of the fore arm: this, when soaked in warm water, is moulded to the shape of the parts, and, when dry, serves to retain them during the remainder of the cure. The fracture may descend between the condyles into the joint, either with or without the transverse fracture: in this case the inflammatory action and swelling are greater. The nature of the injury may be known by observing the motions of the joint to be free, and by the existence of crepitus above. The condyles are movable on one another. The same treatment is to be pursued. Passive motion must be used during the third week, to prevent adhesions in the joint; but however carefully this direction is attended to, the perfect integrity of the articulation is but rarely preserved. Either of the condyles may be broken off by a direct blow; and the inner, as being the more prominent, the more commonly suffers. This accident is often attended with great pain from the pressure on the ulnar nerve, which descends immediately behind that bony eminence. There is rarely any serious displacement in these injuries, and a suitable compress and roller are all the applications necessary.

Fractures of the olecranon.

The *olecranon* is fractured by a person falling on the elbow, as when it is thrust out for support when the hand is engaged. A hollow is felt, the fragment being dragged upwards by the triceps. It may be moved from side to side, but can with difficulty be brought down into its place, even when the fore arm is extended; there may, therefore, be no crepitus. This injury is seldom repaired by bone; and in this and other respects much resembles the fracture of the patella. The fragment is to be brought, if possible, into close contact with the bone, by bracing it down by a compress, after partially extending the elbow. A pad is to be placed in the hollow of the joint in front, with a splint in front of it, to preserve it motionless. Passive motion must be commenced in the third week.

Of the fore arm.

The *fore arm* is much exposed to fracture, from its exposed situation. The injury, whether in one or both bones, is readily detected by grasping the fragments and moving them in opposite directions: if the radius be broken below the tubercle the upper fragment is advanced by the biceps muscle, and the lower drawn inwards towards the ulna by the pronators. The object in this and the other fractures near the middle of the fore arm is to prevent undue approximation of the radius and ulna, and to keep the two fragments of the radius in the same degree of supination; for if the lower be pronated and the upper supinated, and they grow together thus, it is manifest how limited these movements must be in future, and if the bones adhere to one another these motions of course cease. The elbow is to be bent, to relax the biceps; the hand is to be placed supine on a splint reaching to the ends of the fingers; another splint is to be adapted on the front of the fore arm as far as the palm. The limb is then to be brought across the chest, and supported in a sling, the hand being allowed to drop towards its ulnar border. This last precaution is especially requisite in fractures of the radius alone, since the weight of the hand is thus made to act as a constant force counteracting the pronator quadratus, through the external lateral ligament. Fracture of the lower extremity of the radius is a very common accident, and apt to be overlooked from the difficulty of detecting crepitus. The wrist is bent backwards: there is an unnatural prominence in front, just above the joint, with extreme pain. A displacement of the head of the ulna frequently accompanies this fracture. This injury is remarkably prone to be followed by a painful, weak, and almost useless state of the wrist, with deformity. To prevent this, two splints, firmly applied, are to be made use of. It is impossible to counteract completely the powerful and direct action of the pronator quadratus dragging the lower fragment forwards and towards the ulna.

Of the wrist and hand.

The bones of the *wrist* are not liable to simple fracture. The *metacarpal bones* frequently give way under blows received on their distal extremities. The best treatment consists in a ball compress held in the fist, the fingers being bandaged over it: this prevents bulging of the fragments towards the palm.

Of the nose.

The *nasal bones*, when fractured by a blow, are to be restored by a director covered with lint introduced into the nostril. There being no muscular displacing cause no retentive apparatus is necessary, and the case is to be treated as an ordinary contusion. There being commonly great tumefaction, fomentations should be applied. Emphysema occasionally attends this accident.

Of the lower jaw.

Fractures of the lower jaw usually occur between the angle and symphysis, in front of the masseter. The lesser fragment is drawn upwards by the muscles of mastication, and the irregularity is recognized in the row of teeth. When the line of fracture is at the symphysis there is scarcely any displacement, owing to the equal action of the muscles on the two sides. Sometimes the jaw is broken on the two sides at once. Crepitus is always perceptible. The best apparatus is one invented by Mr. Lonsdale, consisting of two curved pieces, one below the jaw, the other fitting on the lower range of teeth, and both fastened by means of a screw. This allows the jaw to open, while it retains the fragments immovable on one another. If it be not at hand, two contiguous teeth may be secured to each other by dentists' silk, and a pasteboard splint applied wet and allowed to dry; the split double-headed roller may be

Surgery.

used in addition, a slit being made in the centre of it to admit the chin. Two of the ends are to be tied over the vertex, and two over the occiput. The ramus or neck of the jaw may be fractured; but the injury, even if detected, is too deeply seated, and the upper fragment is too small, to admit of surgical apparatus being employed to set it. All that can be done will be to preserve the jaw motionless.

Dislocation.

Dislocations.

A dislocation is a displacement of an articular surface of a bone from its natural situation. Dislocations are commonly produced by violence, but they may occur as an effect of mere muscular action, or of relaxation of the ligaments, or deficiency of the structures of the joint, or from disease attended with their destruction. Dislocations from violence may be regarded as contused and lacerated wounds, for the displaced bone being driven from its place into the surrounding muscles or other structures, is attended with more or less injury to them, and with effusion of blood. There is, moreover, the presence of the dislocated bone pressing upon them, and acting to some degree as a foreign body in the new cavity it has formed for itself. The ligaments being designed to limit movement of the joints in certain determinate directions, it is almost invariably only by a rupture of some of these structures, and of course of the synovial capsule, that the dislocation can occur at all. The pain attending dislocations is usually of a dull but severe kind, and arises more from the continued pressure of the bone on the soft parts, and especially on nervous trunks that may happen to be near, than from the extent of their laceration; hence it is almost immediately relieved by the return of the bone to its natural position. The external signs by which a dislocation may usually be known and distinguished from a fracture are the sudden occurrence, after an accident, of some unnatural swelling in the neighbourhood of the joint, with a corresponding alteration of form on the opposite part; great limitation of motion determined by the impaction of the bone in its new site, or by the muscles stretched unduly over its projecting parts; an absence of the grating sound and feel termed *crepitus*, which is distinctive of fracture.

Signs.

It often happens that these signs are obscured by immense swelling of the part, caused, it may be, by effusion of blood, or by effusion of synovia from the torn membrane, or by inflammatory deposits in addition to these. Under such circumstances there is no alternative but to wait until the tumefaction has in some measure subsided, and until it allows the forms of the projections of the joint to be recognized. It is often impossible for the best informed surgeon to determine with accuracy the nature of such injuries; but it is fortunate that he can frequently apply suitable remedies without this precise information. If with this great swelling there is great immobility, not from voluntary muscular efforts to prevent pain, but from mechanical causes, he may suspect dislocation, and must wait for a time before he can hope to reduce it; applying leeches, or fomentations, as he would for a mere bruise. But if he finds preternatural mobility, and, above all, crepitus, he knows that fracture exists, and that, though there may be also dislocation, he must be content to treat the injury as though there were not. These observations apply only to extreme cases; the general rule never to be lost sight of is to restore the displaced parts as early and as completely as possible to their natural situation.

Surgery.

Compound dislocations.

Dislocations in which the displaced bone is forced through the skin are termed compound; they in some measure resemble penetrating wounds of joints, the textures of the articulation being exposed to violent inflammation when laid open with the external surface. The injury done to the soft parts will be often so extensive as to make amputation necessary. The propriety of resorting to this extreme measure will be determined on grounds similar to those existing in cases of severe compound fracture. If an attempt is to be made to save the limb, the bone is to be reduced, if necessary, by sawing the protruding portion, or by dilating the orifice in the skin; the limb is then to be placed in a fixed position, and simple dressings applied.

The consequences of an unreduced dislocation are permanent deformity and more or less impairment of the motions of the joint. The displaced bone gradually acquires a socket among the neighbouring textures, a part of which is usually constituted of the bone near the original joint, and the rest is formed of new bone deposited around, and of ligamentous substance. These new tissues are the result of the pressure which the bone exerts, and the surface which is formed is made smooth and adapted to the configuration of the dislocated bone by the movements of the latter upon it. Thus the movements, which were at first of the most restricted kind, become by degrees more free, and much of the use of the member is restored. Sir Astley Cooper, in his great work on this subject, has admirably displayed the changes consequent on unreduced dislocations.

The joints are the centres of motion of all the bones, and when a bone is removed from its fulcrum it makes another of the new parts on which its extremity rests. The muscular spasm, produced by the pain, presses the bone against these parts, and thus tends to drive it further and further from its former resting place. In almost all dislocations the muscles have been the main agents in drawing the bone from its original position, when from some cause it had been disengaged from the opposite articulating surface. These organs, therefore, usually form the chief obstacle to reduction, and their direction and attachments around every joint should be well studied, in order that the surgeon may be enabled to comprehend clearly how he may best overcome their efforts. He should also know, by the external signs, in what course the displaced bone has run, and what mechanical obstacle to its return may exist. To enter into a consideration of these circumstances would lead us into greater detail than the size of the present article would admit of, and we shall merely notice some general means for removing the resistance of muscular spasm. In the faintness generally consequent on the injury, the muscles are inactive and relaxed, and this favourable moment should if possible be seized for restoring the bone. But it seldom happens that the nature of the accident is recognized so soon; and then faintness may be artificially induced, in obstinate cases, by blood-letting, the warm bath, and tartar emetic, of which perhaps the two last are to be preferred, except in plethoric and muscular individuals, when all of these means may be put in practice simultaneously. The surgeon's mechanical efforts consist, first, in extending or stretching the dislocated limb, so as to bring the displaced surface to its

Surgery.

Dislocations.

natural level, and next, in so moving it, either by direct force applied to it, or by making a lever of the bone, as to replace it on the surface naturally receiving it. Various contrivances have been devised for making extension effectual; the pulleys are universally preferred where sustained and equable force is demanded, but in many cases the simple power of the surgeon's arm will be sufficient. Bandages or towels, fixed to the limb, serve to protect it at the part to which the drag is applied.

Dislocations being sometimes overlooked through carelessness or ignorance, or not being reduced in consequence of the swelling attending them (perhaps the patient was at sea or otherwise out of reach of medical aid), it becomes a question how long after the reception of the injury an attempt at reduction may be justifiable. Sir A. Cooper is averse to make this attempt in the dislocation of the shoulder after three months, and in those of the hip after two; but some cases have been related in which, after a longer interval than these, considerable advantage has accrued from efforts at reduction. It is to be considered that here there will already have been formed a new cavity for the reception of the dislocated bone, while the old one will be more or less filled up, and the surrounding textures will have accommodated themselves to the unnatural posture of the parts. If the bone is made thus to regain its proper situation it often will slip back on the least encouragement, and has to be retained immovable for a time, that nature may undo her previous work of accommodation. But if its complete restoration cannot be effected at one sitting, it may at several, in which gradual efforts are made to disunite its new-formed adhesions, and replace it in its original site. Even though these fail, increased mobility may result sufficient to compensate the patient for the pain he submits to. The surgeon has to guard against rough handling, which will bruise the nerves, tear the vessels, and cause sloughs. A limb thus treated has been paralyzed for life.

Of the hip.

We shall now briefly advert to the dislocations occurring at the principal joints,* among which the first in importance are those of the *hip*, the most perfect example of the ball-and-socket joint, and surrounded by strong and powerful muscles, but liable to dislocation from the extent of its natural motions, and the variety of directions in which forces are capable of acting upon it. For the practical surgeon the study of these accidents possesses great interest, because his success in reduction will depend entirely on a correct diagnosis of the injury. The most common is that in which the head of the bone is thrown upon the dorsum of the ilium, the trochanter major resting near the anterior spine of that bone, and the direction of the neck being upwards and backwards; "the motion of the joint is diminished, the limb is rotated inwards, and its length diminished by nearly two inches; the natural projection of the trochanter is lost, and there is diminution of roundness in the injured hip." "This dislocation may be caused by a fall when the knee and the foot of the patient are turned inwards, or by a blow, whilst the limb is in that position; but it most commonly occurs in consequence of the person falling whilst carrying a heavy weight on his shoulders, or from a heavy weight, such as a mass of earth, falling on the back whilst the body is bent forwards in a stooping posture. We shall give the mode of reducing this dislocation in Sir A. Cooper's own words, from which the reader will obtain also a correct idea of the general plan to be adopted in other severe cases. "Let the patient," says he, "lose from twelve to twenty ounces of blood, or even more if he be a very strong man; then place him in a warm bath, at the heat of 100°, and gradually increase it to 110°, and give him half a grain of tartarized antimony every ten minutes, until he feels some nausea. The patient should now be wrapped up in a blanket and be placed on his back upon a table of convenient height, between two staples; a strong padded girth should be passed round the hip, with an opening in it sufficiently large to admit the injured extremity, and to press upon the perinæum on one side, and the crista of the ilium at its other point of bearing, the extremities of this girth being firmly fixed to one of the staples, so that they form a line continuous posteriorly with the direction of the dislocated thigh. This part of the apparatus is for the purpose of firmly fixing the pelvis, and forms what is termed the counter-extending force. A wetted linen roller is next to be tightly applied just above the knee, and upon this a leathern strap is to be buckled, having two short straps with rings at right angles with the circular part, or, instead of this, a round towel, made into the knot called the close hitch. The knee is to be slightly bent, but not quite at a right angle, and to be brought across the thigh a little above the knee, which position not only places the extremity in the best direction for the extension, but also prevents the apparatus from slipping. The pulleys are now to be fixed to the two rings of the circular girth (or to the towel) and to the opposite staple, thus completing the arrangement of the extending force. The surgeon should now draw upon the cord of the pulleys so as to tighten the whole apparatus, the patient having been so placed that the direction of the extending and counter-extending forces together form a straight line in the direction of the long axis of the dislocated limb. The extension should be continued by drawing upon the pulleys so as to tighten, even to stretching, every part of the apparatus; and should the patient now complain of the severity of the pain, the surgeon should wait a little, to give the muscles time to become fatigued; he then renews the extension, and when the patient suffers much, again rests, until by degrees the muscles yield and the bone approaches the acetabulum. When it reaches the lip of that cavity he gives the pulleys to an assistant, and desires him to preserve the same state of extension, while the surgeon rotates the limb gently inwards, but not with a violence to excite opposition in the muscles, during which act the bone usually slips into its place. When the pulleys are employed, the head of the femur does not usually return with a snap into its socket, in consequence of the continued extension to which the muscles have been submitted having overcome their contractile power: the surgeon has no other means, therefore, of ascertaining whether or not the reduction has been effected than by loosening the bandages and comparing the length of the two limbs, unless he be able to ascertain it from measuring the distance of the trochanter major from the anterior and superior spinous process of the ilium and sacro-coccygeal articulation.

Surgery.

Dislocations of the hip.

* See Sir A. Cooper's work on *Dislocations and Fractures of the Joints*, new edition, by Bransby Cooper, F.R.S., London, 1842; to which we have to express our obligations in preparing the following sketch.

Surgery. Dislocation of the hip.

If it be ascertained that these distances are the same on both sides, it may be inferred that the dislocation is reduced. Such precaution should always be taken before the apparatus is removed; for nothing can exceed the distress which is invariably expressed if the patient be obliged to submit to its second adjustment.

"It often happens that the bandages get loose before the extension is completed, an accident which should be carefully prevented by having them well secured at first; but if they require to be renewed, it should be expeditiously performed to prevent the muscles having time to recover their tone.

"A considerable difficulty sometimes occurs in raising the bone over the edge of the acetabulum; to overcome which a towel should be passed under the thigh, as near the joint as possible, to enable an assistant to lift it. When the reduction is completed the injured limb should be kept parallel with the sound one, by the aid of a bandage; for, in consequence of the relaxed state of the muscles, there is great liability to the recurrence of its displacement unless such precaution be adopted. It is also necessary, as after-treatment, when such force has been employed, to administer both constitutional and local means to subdue the subsequent inflammation. The patient, under all circumstances, should be kept in bed for at least a fortnight after the accident, to allow of the reparation of the inward structure of the joint; and even then, should he be allowed to use the limb, passive motion should be employed."

The dislocation into the *Ischiatic notch* is a variety of that last described, the head only resting nearly on the level of the acetabulum, instead of considerably above it. There is very little shortening, but the same inversion of the foot, and immobility. The head of the bone is deeper and consequently less easily felt; and hence the nature of the injury is more obscure. It is occasioned by force acting on the thigh when bent at right angles to the pelvis, and inclined over the other limb. It may be reduced by laying the patient on the sound side, bringing the thigh over the middle of the opposite limb, and making extension in that direction. As the brim of the acetabulum is deeper behind than elsewhere, the head of the bone must be raised by a towel placed under the thigh near the perinæum. The reduction of this dislocation is not easy.

The dislocation into the horizontal ramus of the *pubes* is marked by distinct signs. The limb is shortened by about an inch, and the foot turned outwards. It is abducted, the knee being directed away from its fellow. The trochanter is sunk, the head of the bone prominent below Poupart's ligament. It happens when a person, while walking, puts his foot into some unexpected hollow in the ground, and his body at the moment being bent backwards, the head of the bone is thrown forwards upon the os pubis. A gentleman who had met with this dislocation in his own person informed me that it happened whilst he was walking across a paved yard in the dark; he did not know that one of the stones had been taken up, and his foot suddenly sunk into the hollow, and he fell backwards. When his limb was examined the head of the thigh bone was found upon the os pubis.* The patient is to be laid on the unaffected side, and the limb extended by means of the pulleys in a downward and backward direction. The head of the bone may then be brought over the brim of the acetabulum by a napkin passed under the thigh.

Dislocation into the *thyroid foramen* is distinguished by very well marked signs. The limb is lengthened by nearly two inches, and the psoas and iliacus muscles being stretched by the head of the bone thrust under them, the thigh is partially flexed on the pelvis; or if the patient stands, he leans forwards, with the foot in advance and the knees widely separated. The trochanter is sunk, and the head of the bone can be felt in its new situation, unless the patient is corpulent. The limb cannot be brought over the opposite one. This dislocation is "generally caused by a heavy weight falling upon the pelvis, whilst the back is bent forwards and the thighs are separated from one another. The ligamentum teres and the lower part of the capsular ligament are torn through, and the head of the bone becomes placed in the posterior and inner part of the thigh, upon the obturator externus muscle." Extension is not necessary. The object is to throw the head of the bone outwards and forwards, after which the muscles will restore it to its socket. This is effected by laying the sufferer on his back with a firm fulcrum (as a bed-post) between the thighs, and the pelvis fixed. The limb is then to be firmly drawn over towards the opposite one, when the desired motion will be communicated to the head. The direction of this may be guided by direct pulling at a towel passed round the upper part of the thigh. Care is to be taken not to advance the limb, lest it should slip round below the acetabulum into the sciatic notch, instead of re-entering the socket.

Of the knee.

Dislocations of the *knee* are rare, which is to be explained by the great strength of its crucial and lateral ligaments. The *tibia* is sometimes thrown backwards towards the ham, but seldom or never completely detached from the condyles, without such injury to the soft parts as renders amputation necessary. The reduction is easily effected, and the limb must be kept bound up and at rest for a few weeks, until all inflammatory symptoms have subsided, and the laceration of the ligaments be repaired. The *knee-cap* may be thrown from its pulley on either side, but may be readily replaced by relaxing the extensor muscles and pushing it into its place. In some rare cases it has been found turned round, so that its posterior surface was anterior, a displacement very difficult to remedy.

Of the ankle.

The *foot* is usually dislocated *outwards* at the ankle with fracture of the fibula, as already described. There is no obstacle to reduction. The *foot* may be displaced *inwards* with fracture of the tibial malleolus. Both these injuries are to be treated as fractures after the parts are reduced. The latter is the more serious accident of the two, more force is requisite to produce it, and it is usually accompanied with more contusion and swelling of the soft parts and more injury to the bones and ligaments. In dislocation of the foot *backwards* the instep appears shortened, the heel lengthened. "The lower extremity of the tibia forms a hard projection upon the upper part of the middle of the tarsus under the projected tendons, and there is a depression before the tendo Achillis. This accident arises from a fall of the body backwards whilst the foot is confined; or if a person jumps from a carriage in rapid motion, with the toe pointed forwards." The fibula is fractured a little above the ankle. The parts are replaced with little difficulty by the aid of moderate extension.

* Sir A. Cooper. *Op. Cit.*, p. 84.

Surgery.

Dislocation of the ankle.

Compound dislocation of the ankle, in which the tibia projects over the instep, stretching the extensor tendons over it, is in general an injury demanding amputation. This is especially the case if the patient be old or in bad health, or if the injury have been caused partly by direct violence. On the other hand, if the patient be young, and there be little contusion of the surrounding structures, an attempt may be made to save the limb. If this be determined upon, it may be necessary to saw off a portion of the protruding bone, or to enlarge the wound, in order to effect reduction. The subsequent treatment does not require particular notice in this place.

Of the foot.

Of the bones of the tarsus the only one subject to separate dislocation is the *astragalus*, which is occasionally shot out of its place and lodged under the skin. The bone is found turned from its natural direction, and sometimes completely reversed, so that its lower surface looks upwards. It is seldom possible to restore this bone; never, if the displacement is complete. It has been cut out in a few instances, and with an excellent result as regards the usefulness of the foot. The skin, if not lacerated at first, rarely escapes sloughing from the pressure occasioned by the irregular projections of the upraised bone.

Of the jaw.

The *jaw* can only be dislocated *forwards*, an accident commonly happening on both sides at once, from yawning, or during a burst of immoderate laughter. The condyles rest on the transverse root of the zygoma, the mouth remains widely open, and the dislocated bone projects. There are depressions in front of the ears, in the natural position of the joint, and the cheeks are bulged. The compressed parotid yields saliva in abundance. It sometimes happens that one of the condyles only is dislocated, and this will be readily recognized. The jaw is twisted from that side. In either case the reduction is easy. The thumbs, armed with a towel, are to be placed on the lower molar teeth, and the jaw depressed; the front of it is now to be elevated by the fingers, when the condyles are lowered and slip back into their sockets with a snap. Some persons appear liable to this accident from an original weakness in the maxillary articulation, and those who have once suffered from it are very subject to its recurrence.

Of the clavicle.

The *clavicle* may be dislocated by the same kind of force which usually produces fracture of the bone. It may give way at either extremity. Its sternal end may ride inwards over the front of the sternum, or its acromial end upwards upon the process of that name. Both of these displacements declare themselves by evident signs, and both are very apt to return after reduction. The treatment is the same as that required for fracture of the clavicle, and its object is to elevate and keep outwards the shoulder. Moderate pressure, however, must here be made on the clavicle to counteract its tendency to slip again from its position. The bandages must be worn longer in these than in most other dislocations, and whatever care be taken some deformity will remain.

Of the shoulder.

The *humerus* may be dislocated at the shoulder in several directions, but of these by far the most important is that into the *axilla*. The causes of this dislocation, according to Sir A. Cooper, are falls upon the hand or elbow when the arm is raised from the side; but the most frequent cause is a fall directly upon the shoulder on some uneven surface, by which the head of the bone is driven downwards, whilst the muscles are unprepared to resist the shock. The head of the bone rests against the scapula and subscapular muscle, immediately below the glenoid cavity. The capsular ligament being ruptured in that direction, the great vessels and nerves are often compressed by it. The limb stands out from the side and cannot be brought to it without great pain. The shoulder loses its rotundity, seems flattened, and a depression may be felt below the acromion. The deltoid passes towards its humeral insertion at an unusual angle, and the head of the bone is readily distinguished in the axilla, if the arm be raised. There are many modes of reducing the humerus from the axilla. The pulleys may be employed: the arm is raised to a right angle with the chest. Extension is made from the lower end of the humerus and counter extension by a band passed round the thorax and scapula. When it has been continued sufficiently long the surgeon is to place his arm under that of the patient close to the axilla and lift the humerus towards the glenoid cavity, at the same time depressing the elbow towards the side. Another method less formidable in appearance, and which rarely fails, is as follows:—The patient lies on a sofa, while the surgeon, taking off his shoe, places his heel in the axilla, and then makes gradual extension by the wrist, or by means of a towel passed round the limb above the elbow. In a short time he brings the arm over the chest, making a fulcrum of his heel, when the bone re-enters the socket with a snap. The brachial plexus of nerves is apt to suffer in this operation, though, if it be done dexterously, but little force is required. Or the arm may be forcibly elevated towards the head, in doing which the acromion is converted into a fulcrum and the articular extremity lifted out from the hollow into which it had sunk.

Surgery.

Dislocations of the houlder.

The three other dislocations of the head of the humerus are *forwards* under the clavicle, *partially forwards* under the coracoid process, and *backwards* below the spine of the scapula. In the former of these the symptoms are even more evident than in that into the axilla, the acromion being more pointed and the hollow below it more considerable: the head of the bone is on the inner side of the coracoid process. In *partial dislocation* the head of the bone is drawn forwards against the coracoid process; there is a depression opposite the back of the shoulder-joint, and the posterior half of the glenoid cavity is perceptible. The elevation of the limb is prevented by the head of the humerus striking against the coracoid process. In these dislocations the same measures (with slight variation in the direction of the extending force) may be pursued with success. The dislocation *backwards* is a rare accident, but cannot be mistaken, as there is "a protuberance formed by the bone upon the scapula, which immediately strikes the eye, and when the bone is rotated the protuberance rolls also. The motions of the arm are impaired, but not to the same extent as in either of the other states of luxation; and the direction of the limb is obviously behind the glenoid cavity." This dislocation is easily reduced either by throwing the arm upwards and behind the head, or by extension over the chest, or directly downwards.

Of the elbow.

Dislocation of the *radius and ulna backwards* is not uncommon in young persons, in whom the coronoid process of the ulna is still small. The boy falling forwards on his hand, the ulna slips backwards over the trochlea of the humerus, and carries the radius with it,

Surgery. Dislocations of the elbow.

The coronoid process rests in the olecranar fossa, and the olecranon itself, with the head of the radius, projects behind in a very characteristic manner: the fore arm is shortened, and there is an unnatural prominence in front of the joint. By a variety in the direction of the force, these bones may be dislocated *outwards* or *inwards, as well as backwards;* in which cases the signs are similar, with the exception of the lateral displacement, which is respectively present in each. Thus, in the first, the head of the radius is felt behind, and to the outside of the external condyle; and in the second, the external condyle seems unnaturally prominent. The *ulna* alone may be dislocated *backwards*, the radius maintaining its situation on the articular surface of the humerus. The fore arm is fixed at a right angle with the arm, and much pronated by the drag on the pronator muscles, caused by the separation of the two bones. All these varieties now mentioned have the common character of great prominence of the olecranon behind. They may all be reduced by similar means, the readiest and most effectual of which consists in the surgeon placing his bent knee in the hollow of the joint, and gradually flexing the articulation still more. Each bone is converted into a lever, for which the knee serves as a fulcrum, and thus the bones are disengaged from one another. The coronoid process is lifted out of its bed, and over the trochlea, and returns to its true position on the force being intermitted. The *radius* may be dislocated *forwards*. This accident is not rare in children, but is often overlooked from the facility with which it is reduced. In adults it is rare, but is also easy of reduction. The fore arm is pronated and semiflexed; the head of the radius is felt as a prominence in front of the humerus, above its natural place, and may be seen to strike against the humerus on bending the elbow. By making extension by the hand, the bone is brought down. A dislocation of the *radius backwards* is described, but is very rare. The head of the bone projects behind the outer condyle, and may be at once reduced by forcibly bending the elbow.

Of the wrist.

Dislocations of the *wrist* are uncommon, the displacements attending fractures of the lower end of the radius being often mistaken for them. The carpal bones may, however, in rare cases, be dislocated either forwards or backwards on the radius and ulna. These accidents will be easily understood by the form of the projecting bones, if they are seen at an early period after the injury; but when tumefaction or chronic thickening has taken place, they may be confounded with fracture of the radius. The reduction is easy, but the usual means for counteracting inflammation must be afterwards vigorously pursued, and the hand and arm confined on a splint. A weak joint is commonly the result. The radius is sometimes separately thrown upon the fore part of the carpus, and lodged upon the scaphoid bone and the os trapezium. The outer side of the hand is, in this case, twisted backwards, and the inner forwards: the extremity of the radius can be felt and seen. This, and the separate dislocations of the ulna, which are rare, do not require further mention in this place.

Of the hand.

The dislocations of the thumb and fingers are generally difficult of reduction, in consequence of the smallness of the part from which extension has to be made, the great strength of the lateral ligaments, and of the muscles which resist extension. The nature of the injury is at once evident. Extension is to be made by the knot called the clove-hitch, which becomes tighter the more it is pulled upon. It sometimes happens that even long-continued extension by pulleys fails in reducing the dislocations of the thumb. Under such circumstances, it has been recommended to divide the lateral ligaments of the joint, and this has sometimes succeeded, but it is apt to be followed by severe inflammation and destruction of the joint; and it is therefore perhaps the better plan to leave the dislocation unreduced, as a very useful state of the member may even then be obtained.

Surgery. Dislocations.

Diseases of the bones.

Diseases of the Bones.—Under this head we shall give a brief description of the principal varieties of disease affecting the osseous tissue. Bones being highly vascular organs, are liable to most of those diseases which affect the rest of the body; such as unnatural growth, or hypertrophy; deficient growth, or atrophy; inflammation, acute and chronic, with its results,—enlargement, ulceration or *caries*, suppuration, mortification or *necrosis;*—and morbid deposits or growths. The bones present great variations of size within the limits of health; their non-articular eminences are well-marked, in proportion to the muscularity of the subject. In the female, for instance, they are less distinct than in the male; in the powerfully muscular man, they are at the maximum of development. As Sir Charles Bell has remarked, a person of feeble texture and indolent habits has the bone smooth, thin, and light; while with the powerful muscular frame is combined a dense and perfect texture of bone, where every spine and tubercle are well developed. And thus the inert and mechanical provisions of the bone always bear relation to the muscular power of the limb; and exercise is as necessary to the perfect constitution of a bone, as it is to the perfection of a muscle. It is an interesting fact, that if a limb be disused from paralysis, the bones waste as well as the muscles.

Exostosis.

Exostosis is a term now restricted to tumors of true osseous tissue, growing from the surfaces of bones: they are slow in their progress, and not inclined to involve other structures, or to prove hurtful except by their size or position. They generally commence without assignable cause, and are more prone to appear on the femur, tibia, bodies of the vertebræ, cranial bones, and last phalanx of the great toe, than in other bones: they may occur either with a broad or narrow base. This disease is recognized by the hardness and fixity of the swelling, and by its history. If it be deemed necessary to remove it, this may be usually accomplished without difficulty by means of the cutting pliers if it be pedunculated, or by the saw if its attachment be broad. Care is to be afterwards taken to suppress inflammation, which is apt to extend along the bone into neighbouring joints. The disease is not liable to return.

Atrophy.

There are two forms of atrophy of bone, independently of those in which the osseous tissue is absorbed through the pressure of some encroaching disease: these are commonly known as *rickets* and *fragility* of the bones. The former, so common among the children of scrofulous parents, and in the ill-nourished ones of the lower orders, consists in a deficient deposit of earthy matter, the animal matter being probably of an unhealthy quality. In this disease the bones are so flexible, that they bend gradually under the weight that they may be called on to support, or under the ordinary continued action of the muscles. The lower extremities exhibit deformity first, and to the greatest degree;

Rickets.

Surgery. Rickets.

and the direction in which they become bent is evidently influenced by the superimposed weight: the bend almost always appears as an aggravation of the natural curves of the bones. The rickety femur has always its convexity directed forwards; the tibia is convex forwards and outwards, and the fibula follows the same direction. When the nutritive powers of the system are fully restored, the deposition of earth goes on in its healthy proportion, the animal matter becomes healthy, and the bones acquire their due degree of strength and hardness. In the tibia of a rickety child Dr. Davy found, in one hundred parts, seventy four animal matter and twenty-six earthy, instead of about an equal quantity of both. Rickets, as already hinted, is only one part of a constitutional disease. It is usually preceded by paleness and flabbiness of complexion, impaired appetite, disordered assimilation, with unhealthy evacuations, and enlarged liver. The first indication of treatment is to correct the constitutional state: this is to be done by attention to air, exercise, and diet, by attention to the excretions, and by the exhibition of tonics. It has been attempted to favour the deposition of more earthy material in the bones by the exhibition of muriate of lime and phosphate of soda, in minute doses, long repeated; but experience has not served to confirm the hopes of benefit from these remedies that a consideration of the pathology of the disease appeared to hold out. With regard to exercise, it is obvious that it cannot be taken in the ordinary way, on account of the increased deformity that would necessarily result. The child is, therefore, to be encouraged to play about on the floor, or on the bed. If the affection be slight, and be limited to the legs, further distortion may be in some degree prevented, by the judicious use of steel spring supports, which have been employed for this purpose from an early period.

Fragility of the bones.

The *brittleness* of the bones in old age is due to an opposite cause, namely, the defective deposit of animal matter, so as to give an undue preponderance to the earthy material. But this state can scarcely be regarded as morbid: it is the natural result of the feeble condition of the powers of nutrition, which ensues in the advance of years, and it will vary in different individuals according to the original strength of constitution of each, and according to the freedom from exposure to debilitating influences. This *fragilitas ossium* is strikingly exemplified in the fracture of the neck of the thigh-bone, or through the trochanters, on a very slight fall. "When," says Sir C. Bell, "an old feeble lady, who has long kept her bed, trips on the carpet and falls on her haunch, the top of the thigh-bone is shattered like a piece of China."

Mollities ossium.

There are several forms of disease which lead to the destruction of the texture of the bones, by the deposit of some new and morbid material from the blood circulating in their pores. Among these we do not include the results of inflammation.

Mollities ossium is a term denoting a peculiar degeneration, by which the bones become soft and wax-like, and bend during life into very distorted shapes. The cancelli and minute canals of the bony tissue are loaded with a lardaceous substance, which augments at the expense of the natural structure, until a mere papyraceous shell remains, retaining the original configuration of the part, but which is so soft that it may be readily cut with a knife. This is a rare affection, of slow progress, and attended with pains in all the tainted bones. The subjects of it are usually adults, in which respect, as well as in the nature of the deposit, it differs from rickets. The constitutional symptoms that accompany it are such as denote a grave disorder of the nutritive function. Fœtid sweats and abundant urinary sediments are among the most remarkable of these; but little satisfactory is known as to the nature or treatment of this formidable disease, and it appears to advance in spite of remedies. The distortions of the pelvic bones in females, by which the cavity is rendered too narrow to allow of the extrusion of the fœtus, and the Cæsarian section is made necessary, are among the most serious evils attendant on this affection. The sacrum is thrust down by the weight of the body communicated through the vertebral column, and the sockets of the thigh-bones being kept up by the resistance of the lower extremities, the pelvic cavity is sometimes almost completely obliterated between these parts.

Surgery. Mollities ossium.

Malignant formations in bone. Cancer.

The foregoing disease has been frequently confounded with *malignant formations* in bone. Of these there are several varieties, all of which are usually coincident with the same diseased growth in other organs. The first is very apt to be present in middle-aged or elderly persons, chiefly females, who have been affected with the ordinary cancer of the breast. It is an interstitial deposit within the medullary cavity and cancelli of the bone, formed from the vessels of the medullary membrane, not expanding the bone, but causing its gradual absorption, so that such a bone when macerated exhibits numerous holes and deficiencies, as though worm-eaten. Such bones are of course rendered very brittle, and give way often on mere muscular exertion, at such places as have suffered the most from the aggressions of the morbid growth. These bones may be fractured as the patient turns himself in bed. The accident is accompanied with very little injury to the surrounding textures, and scarcely any blood is effused. No attempts at reparation are made, and indeed such occurrences, as they mark an advanced stage of the general malady, are commonly the forerunners of a speedy dissolution.

Medullary or hæmatoid sarcoma.

Another form in which cancer attacks the bones is that of the medullary or hæmatoid tumor, developed in the interior of their cancelli. This may occasion a swelling perceptible externally, and by its softness and elasticity giving a very deceptive feel of fluctuation to the fingers. If seated near a large artery, it may also acquire from it a very perceptible pulsation, which will have something of the diffused and expansive throb of an aneurism. This form of disease may occur in any bone: it often affects many at the same time; but the cranial bones, the humerus, and femur are those most liable to it. It generally appears at an earlier age than ordinary cancer, and may consist either of a uniform size-like mass of new material, or of a more vascular multilocular tumor, containing in its cavities blood, serum, or cerebriform structure. This last is the *fungus hæmatodes* of Hey, and is a malignant disease of very active powers of growth. If allowed to remain, it encroaches on the surrounding parts, and, approaching the skin, may burst through it, and expand as a bleeding and rapidly protruding fungus. Amputation performed at this stage has often proved ineffectual, the same disease recurring in the textures of the stump. And indeed the alternative afforded by the operation, where it is practicable, even at a much earlier stage, is so poor a

Surgery. Tumors in bone.

one, that it may be doubted whether it will not accelerate death more often than it will eradicate the disease from the system. There are, however, cases of undoubted authenticity on record, where the disease has not re-appeared elsewhere, after early amputation, at least during a period of several years.

In a third variety, the morbid growth forms a tumor between the periosteum and the surface of the bone, the latter itself remaining nearly in its natural state. The new texture may be of various degrees of consistence and colour. It sometimes is soft and vascular, and of a dark sanious appearance, not unlike coagulated blood, and into this there may shoot a forest of spiculæ and laminæ of osseous tissue from the surface of the bone. When macerated, the new bone wears the very beautiful appearance often exhibited in museums under the name of *spiculár* or *lamellar exostosis:* but the osseous transformation seems an unessential feature of the disease. This variety occurs more often in the head than elsewhere. At other times the growth is of moderate consistence, and similar in general aspect to a mass of brain; but more frequently it is of considerable firmness, and in parts approximates to the cartilaginous condition, and contains gritty particles.

Acute inflammation of bone.

Inflammation of bone occurs in several forms. Acute inflammation of the whole shaft of the femur or the tibia sometimes follows a slight blow, or exposure to cold, in children, especially those of the poorer classes, who are ill fed and poorly clothed. At the onset there is great and deep-seated pain of the limb, aggravated by pressure, with shiverings and all the other signs of severe symptomatic fever. The motions of the part can no longer be performed, and the patient refuses to bear his weight on the leg. The whole limb, in the interval of the joints, swells, and in the course of a week or more fluctuation becomes apparent, pus having formed between the periosteum and the bone, and burst out under the muscles. If the case be neglected, the matter extends in various directions among the soft textures, and makes its way to the skin in different places. If the cavity of the abscess be now explored with a probe, the shaft of the bone is found bare, and bathed in pus, and this sometimes so extensively, that the entire shaft is uncovered and dead. The most active measures are demanded from the very first commencement of the attack, to arrest the morbid action. Leeches, fomentations, with brisk aperients, are to be employed, and the part frequently examined, with a view to detect the first evidence of fluctuation, after which a free opening is to be made. If the symptoms are unremitted during a week, even though fluctuation be not perceptible, it is best to make an explorative puncture, because matter may form at that great depth without giving the ordinary evidence to the fingers, and an early evacuation is most important to prevent its burrowing and extending to other parts.

It seldom happens that an affection, so severe as we have now described, terminates before the limb is rendered utterly useless, by the destruction of nearly the whole bone, and amputation becomes the only resource.

Inflammation of the periosteum and surface of bone is usually partial, and connected with some constitutional taint, such as syphilis, or the mercurial cachexy. It occurs chiefly in exposed situations, as on the shin, border of the ulna, or the cranial arch, and the swelling occasioned by it is termed a *node*. Nodes vary much in their activity. Matter may form between the periosteum and bone, and may even open on the skin. The surface of the bone is then found bare, spongy, and inclined to exfoliate. Or matter once formed may be re-absorbed by the aid of blisters repeatedly applied over the part. Even though suppuration do not occur, the bone will swell and become spongy, new bone being deposited, and the periosteum thickened by an infiltration of lymph, this forming the chronic node. The general treatment is to be conducted on principles laid down in the article MEDICINE. The local applications are leeches, fomentations in the early stage, blisters, iodine, or mercurial plasters in the chronic stages.

Surgery. Diseases of bone.

Chronic inflammation of bone.

Chronic Inflammation may attack an entire bone, and even several bones, as a consequence of some constitutional complaint, the bones most liable to it being those of the leg. Its access is gradual, with pain of a dull, heavy kind, and deep-seated tenderness. The affected bones enlarge, the limb acquires a large misshapen appearance, the muscles falling away from inaction. This state of the bone is sometimes brought on by some slight accidental injury, acting in union with some predisposing cause, and in such instances the inflammation may run so high at the seat of the injury as to terminate in the death of more or less of the bone. This is what is technically called *necrosis:* the dead portion is detached by a slow absorption of the living bone in contact with it, and becomes loose, under the name of *sequestrum*. This lies in a cavity, surrounded by a mass either of newly deposited bone, or of old bone modified by inflammation, and from the surface of the cavity pus is secreted, which makes its way outwards through apertures in its sides, termed *cloacæ*.

Treatment

The treatment of chronic inflammation of bone consists of all those measures which tend to improve the general heath, with rest, leeches, fomentations, and counter-irritants to the bone. Alterative mercurial medicines are generally of service, with iodine, quinine, or sarsaparilla, according to circumstances. When a portion of bone dies, the local swelling, the pain, the discharge of matter continue, and a probe introduced into the aperture commonly enables the surgeon to detect the presence of the sequestrum. If this be large, there will probably be several cloacæ, but it is often quite impossible to determine with accuracy the size of the dead portion. Under these circumstances a sufficient length of time having elapsed to allow of the complete separation of the sequestrum from the yet living parts, incisions are to be made down to the diseased bone, large enough to permit the extraction of the fragment. As it commonly happens that it is too large to be withdrawn through the cloacæ, the new bone that encloses it is to be cut through either with trephine, chisel, or saw. The sequestrum having been disengaged, the wound is to be dressed with lint and a poultice, the external part being left open to give escape to loose particles with the discharge, and then healing by granulation. The operation now described is sometimes a very severe one, and it is always attended with considerable suffering from the tenderness of the inflamed bone; but the relief that follows it is so immediate and permanent that there can be no doubt of its advisability at an early period, in the great majority of cases where a sequestrum has been ascertained to exist. There is no other cure; the sequestrum cannot, as was formerly supposed, be absorbed or dissolved by the pus that bathes its surface, and the patient is doomed to unceasing torture and anxiety, as well as to

Surgery. Diseases of bone.

the inconveniences of an useless limb, as long as the sequestrum remains. Amputation has often been desired and performed for an old necrosis, but surely the operation just described is in most instances to be much preferred.

When the surface of a bone is destroyed, either by being stripped of its periosteum, or by the progress of an ulcer, or by any other cause, the dead part will separate as a lamina from the sound part below. This is termed *exfoliation*. It differs from the process last-mentioned in the absence of any new bone thrown out over that which has lost vitality, so that there is rarely any delay in the removal of the dead portion.

Abscess in bone.

An occasional consequence of deep-seated inflammation in bone is *abscess*. It would appear that a degree of this morbid process, which would terminate in necrosis in the compact texture of a bone, may lead to the formation of abscess in the cancellated or more vascular and extensible part. The abscess is chronic, rounded, circumscribed, and lined by a cyst. The surrounding bone becomes dense and thickened, but there may be little swelling apparent externally. These abscesses occur in the diploë of the flat bones, and in the spongy extremities of the long bones. The tibia seems peculiarly prone to be the seat of them. They are characterized by deep-seated, severe, aching pain, confined to a limited space, and incessant through many months or years. The only effectual treatment will be to cut down upon the bone, and to trephine over the spot indicated by the pain, as recommended by Sir B. Brodie. If matter be found, relief is at once obtained. If not (and this has happened), the patient is not necessarily in a much worse condition than before, for the aperture made by the trephine is soon filled up by granulation.

Caries.

Caries is a term not limited by custom to any one diseased condition of bone. If an ulcer over the shin penetrate to the bone, it occasions inflammatory action on its surface, with some enlargement, and a state of spongy softening. The bone is carious. Again, if the cancelli of the tarsal bones take on a chronic strumous inflammation, leading to a thickening of their medullary membrane, and a morbid deposit in the cells, by which parts are necrosed, other parts suppurate, and the osseous texture becomes greatly altered in consistence: this too is caries. The latter form of disease is far the more important, and is always associated with a disorder of the constitution of a scrofulous kind. It attacks for the most part the irregular bones, which have a large quantity of the cancellated tissue, such as the vertebræ and the tarsus, and the same form of disease is common in the spongy extremities of the long bones. Its first progress is insidious, gradual, and not marked by much pain or swelling, the only symptom being some uneasiness in walking, or when the bone is in any way subjected to continued pressure. As the slow results of the inflammation become developed, swelling occurs from the participation of the soft parts, the periosteum, synovial membranes, and surrounding cellular texture, in the morbid action, the tenderness increases, the figure of the affected region is altered, its hollows are filled up, and it assumes the form of a rounded uniform tumor. Meanwhile matter is being deposited either in the cancelli of the bone, or in the neighbouring structures, or in both, and abscesses appear and open on the surface by ulceration. Portions of the cancelli also perish, and the joints are destroyed. This condition of parts may continue a very considerable period, without amendment or deterioration; and if the general health is such as to withstand the sappings of the disease, anchylosis may occur between the affected bones, the dead tissues may be evacuated, and the morbid action in those that remain may gradually pass into an inactive state, and the patient recover after many years, without the loss of the limb. But unfortunately this cannot be said to be the common course of this serious affection. The health becomes in general too much undermined to warrant hopes of the life of the patient being preserved, unless the system also be relieved from the morbid influence of the disease. Under these circumstances, it becomes the surgeon's duty to counsel the removal of the part. If the affection be of small extent, limited to a particular bone, and superficially situated, incisions should be made upon it, so as to expose it entirely to view, and all that can be removed is then to be chiselled or scraped away, and a surface of healthy bone left to granulate and heal, which it will readily do, and thus cut short the misery and protracted anxiety of years.

Surgery. Caries.

But it too frequently happens that this circumscribed operation would be insufficient to exterminate the diseased parts, the affection being so general as to occupy the principal portion of some particular segment of a limb. There is then no alternative, if the general health be dangerously impaired, but to separate the entire part from the rest of the system. Accordingly amputations in the civil hospitals are performed for this disease in some or other of its forms more often than for all other causes combined. And yet modern surgery has to boast of a very considerable diminution in the total number of amputations, by reason partly of the more scientific treatment of the disease in its early stages, and partly of the partial operations which are now frequently practised in instances where it used to be thought necessary to sacrifice the whole limb.

Of Burns and Scalds.

Burns and Scalds.

Burns and Scalds are among the severest injuries that can be inflicted on the body, and from their peculiar nature have generally received special attention from writers on practical surgery. They differ from one another chiefly in the depth of the parts affected by them, burns often destroying the entire skin, and even the textures subjacent to it; while the effects of scalds are confined to the surface to which the heated liquid is applied. These varieties of injury may, however, be conveniently spoken of together. The immediate effect of heat applied to the body is a smarting pain, soon followed by a redness, and if the temperature has been at all high, by the formation of vesications, the cuticle being raised from the true skin by serum poured out by the excited vessels of that structure. A still greater heat will destroy the vitality of the integument, and reduce it to a blackened mass. Any of these degrees of injury, if confined to a small spot, are trivial; but they become dangerous and fatal by their diffusion over an extensive surface of the body. In the latter case they arouse wide-spread inflammation, and corresponding constitutional symptoms, and interfere besides with the function of one of the most important secreting organs in the œconomy. Thus a superficial scald of the whole body proves as rapidly fatal to life as a burn involving a much greater destruction of tissue, provided it be of limited area.

Those burns that seriously affect the constitution may be termed *constitutional*, in contradistinction to those that are chiefly important from their topical effects, and which may be styled *local*. We shall briefly consider these in order. Collapse, sudden and extreme, follows an extensive burn as certainly as it does the tearing of a limb from the body. The sense of cold is exceedingly remarkable, and often seems to engage the whole attention of the sufferer: the countenance is pallid and terror-stricken, and the voice wild. Vomiting very generally supervenes if there is any attempt at re-action, and this vomiting will recur again and again, and is at once excited by whatever enters the stomach. If these symptoms continue several hours, the patient cannot survive, but dies from the effects of shock, with more or less attempt at re-action. To a person under these circumstances, ammonia, opium, and wine are indispensable from the first, and should be administered in small quantities and at frequent intervals, and, if necessary, be thrown into the large bowel in the form of enema. They soothe the nervous system, and encourage a revival of the drooping energies of life: it is needless to say that warmth must be added to these. The topical application to be made in such cases will consist of oily substances, which are the most agreeable to the patient. In less extensive burns, attended with destruction of skin, but without very severe constitutional symptoms, much difference of opinion did and does prevail as to the local treatment most suitable. The stimulant plan, known as that of Kentish, of smearing over the burnt parts a liniment containing turpentine, has received the sanction of general experience, and is the one most followed in this country. An extraordinary relief from pain is often known to ensue on this application being made, and it is supposed to expedite those processes which end in the detachment of the dead from the living parts, by stimulating the vessels of the latter: there is no doubt that turpentine will penetrate through a hard dry slough of the integument. In all instances the element will have acted with varying intensity on different parts; and while some will have been completely scorched up, others will have been only singed, and the cuticle raised in blisters. These last will have to be treated in a different manner. If the vesications be large, they may be snipped; but the epidermis should be permitted to remain, as it forms the most appropriate covering to the excoriated surface beneath. Over this, and such parts as may have been deprived of it, the best application is a mixture of oil and lime-water, which admits of being easily smeared on with a feather, and renewed without disturbance to the patient, or simple cerate may be spread on lint, and confined by bandages. These methods of treatment will apply respectively to burns of slighter extent. Cold is quite inapplicable to all large burns, from the depressing influence it exerts on the entire system; but it may sometimes be advantageously employed as a remedy in slight burns of the extremities. It is inadmissible on the trunk of the body in this as in most other cases.

Death may occur either before re-action, or from the secondary consequences of the injury during the inflammatory stage in the wounds, or from certain internal complications arising out of it; or, lastly, in the course of weeks, or even months, from the slow advance of debility, hectic, and colliquative diarrhœa, the effects of protracted and profuse suppuration from the sores left after the separation of the sloughs. Bronchitis and diarrhœa are not unfrequent precursors of death at the early period mentioned, and their accession has been commonly assigned to the vicarious activity of those surfaces, induced by the interruption caused to the cutaneous function. But though the truth of this explanation may be doubted, it may serve to evince the importance of keeping up the secretions of those membranes by suitable medicines. Where the person has been enveloped in flames for some moments, some of the flame may have been inhaled, in which case it will have scorched the mouth and glottis, and necessarily have excited inflammation capable of penetrating along the bronchial surface. Ulcers in the duodenum have been found in many cases of death after recent burns, and in some instances these have been the occasion of death, by opening the artery running between that intestine and the pancreas; but what may be the connexion, if any, between these ulcers and the burn, does not yet appear. It has been remarked by those who have had large opportunities of witnessing the terrible effects of fire on the children of the poor, who fall victims to it in great numbers every year in our large towns, from the imperfect care of their parents, who are engaged in the manufactories, that the issue depends in no small degree on the situation or region of the burn. Those of the trunk are, *cæteris paribus*, more dangerous than those of the extremities, and those of the back than those of the front of the body; the reason whereof appears to be this chiefly, that the means of relief cannot be so well applied and retained on one part as on another, and that certain burns mechanically interfere more with the processes necessary to life. A patient with an extensive burn on the back cannot rest or sleep except in an unnatural posture, and soon becomes exhausted.

Ulcers remaining after burns.

The ulcers remaining after burns that have been attended with great destruction of the cutaneous texture, are often very intractable. It is in these large suppurating surfaces that the inter-dependence of local and constitutional conditions is best exhibited, and most necessary to be closely watched, with the view of determining on treatment. Exuberant and florid, or flabby and pale granulations, co-exist with and respectively mark strength or debility in the powers of the system; and the ulcerative or sloughing process, from time to time recurring without any obvious local cause, sufficiently attest some fault in the nutritive functions of the whole body. On the other hand, the weakness, the hectic, the diarrhœa, the pulmonary disorder, which are so frequently the forerunners of dissolution in the course of these protracted ulcers, are themselves generally the consequence of the drain of the system from the sores. These are cases where the efforts of nature are especially to be seconded by art: there is no disease to combat, only the reparative action has to be sustained. For this purpose the constitutional symptoms are to be treated as they arise, regard being paid to this general rule, that all the functions should be preserved in as healthy a state as possible. In the local treatment a great variety of remedies have been employed, far too numerous to mention. They act on the principle either of excluding the air, or of protecting the newly forming skin, or of stimulating or enfeebling the action of the sore. Among them are chalk, calamine powder, lotions of alum, sulphate of zinc, or nitrate of silver, simple lint used as a compress, &c.

Cicatrices left after burns.

The cicatrices left after burns are very prone to contract and to deform, or render useless the parts of the body on which they are situated. Thus cicatrices on the neck will drag down the cheeks and under-lip, so as to expose the cavity of the mouth; the eyelids may be permanently everted, the flexures of the joints made rigid, the fingers or the whole hand puckered up by these consequences of so great a loss of the healthy structures; and but little can be done to avert these lamentable occurrences. They depend on an interstitial absorption of a portion of the substance of the cicatrix, so that what remains is not sufficient to cover the surface, and the surrounding parts are drawn in to make good the deficiency. During the healing, such a posture may be preserved as may have the effect of moulding the contraction to the most convenient direction; and it is sometimes possible, by incising or cutting out old and rigid cicatrices, and healing them anew with more attention to position, to correct deformities both unseemly and disabling.

Of the Effects of Cold.

Effects of cold.

These vary much with the powers of resistance in different persons. The natives of tropical countries will suffer from a degree of cold which those of colder regions ordinarily experience; and persons debilitated by want of food, by fatigue, or other causes, will be less able to bear a low temperature than those who generate much animal heat, and are provided with the means of œconomizing it by proper clothing. The benumbing effects of cold on the whole system are manifested by torpor and somnolence; and these, if allowed to gain ground, lead to a complete indifference to life, under which the unfortunate sufferer blindly lies down to sleep, never afterwards to awake. The instance of Dr. Solander is well known, who, on an excursion into Terra del Fuego, after warning his companions not to yield to the inclination to sleep, which he foresaw the intense cold would occasion, was the first to give way to its irresistible influence, and was only saved by the persevering exertions of his comrades in urging, and even compelling him to walk. This deep sleep is apparently the consequence of congestion of the brain.

But the local effects of cold are those which most frequently come under the attention of the surgeon. Parts of the body exposed to cold, such as the extremities, the nose or ears, become at first of a dull red colour, from the atonic dilatation of the small vessels, and the accumulation within them of the blood, which is at the same time impelled more feebly by the central organ. A further degree of cold will drive this blood from all the smaller vessels, and occasion a great diminution in the size of the part, which then becomes deprived of feeling and motion, and may be actually frozen, though this happens far less often than is imagined. The part thus affected may be destroyed, but more often vitality will return with returning warmth, and a restoration of the circulation. This re-action is very prone to run on to an excessive degree, and to be converted into inflammation, having a tendency to terminate rapidly either in vesication or sloughing, according to the amount of the previous cold. To prevent these consequences, the utmost care is required not to allow re-action to be completely established until the tone of the affected vessels shall have been, in some measure, restored; and this is best secured by applying warmth very gradually by frictions with snow or snow-water in the first instance, and afterwards by warm flannels. The temperature of the parts, when regained, should be preserved uniform by fomentation; or if sloughs are forming, by poultices, which are to be continued until the dead parts separate, the sores being afterwards treated as usual. The complaint called chilblain is the result of often-repeated exposure to cold not excessive. The fingers or toes are swollen, and of a dull red colour, the vessels having become dilated, and retarding the flow of blood. These may advance to suppuration in consequence of undue reaction following any unusual exposure, in which case they are to be poulticed; but in general they are to be rubbed from time to time with stimulating embrocations, with the view of restoring the healthy contractility to the minute blood-vessels. Regular and brisk exercise, and sufficiently warm clothing, with a nutritious diet, are the best preventives against this and other disorders arising from external cold.

Effects of cold

Of Hernia.

Hernia.

Hernia is understood to mean, the protrusion of any viscus from its natural cavity; but the term, when used alone, in the ordinary language of surgery, is limited to protrusion from the abdominal cavity, such being infinitely the most frequent. Traumatic hernia from the cranial cavity has been already spoken of; and hernia of the lungs may take place, in rare instances, through the walls of the thorax; but the physiological construction of the latter cavity is such as to predispose against this protrusion, there being ever a tendency for parts on its exterior to be drawn into it, rather than for its natural contents to be forced out. On the contrary, the abdominal viscera are constantly pressed upon on all sides by the walls which enclose them. Nothing can enter this cavity except by a direct extraneous propulsion, as when the food is driven forwards into the stomach by the rapid peristaltic action of the gullet; but the compression continually exerted by the parietes on the viscera is a never-ceasing cause tending to produce their expulsion at any point weaker than the rest. Now, the abdominal walls are of very unequal strength, being formed partly by bone, and partly by muscles with their tendons, but in such a manner as to allow certain structures naturally to pass though them in determinate situations. It is almost invariably at such natural apertures, or passages through the walls, that the viscera are found to protrude. Sometimes there is a predisposition to hernia in the special original conformation of the parts, which may be favoured by all causes known to affect the healthy development and nutrition of the fœtus or infant. Even where there may be no herniæ existing, considerable varieties in the strength of the defences at the various apertures are met with, and are well known to all conversant in dissections. But the most common occasion of herniæ is to be found in the undue straining and pressure to which the abdominal viscera are subjected in the pursuit of laborious employments in large towns, where the natural powers are but too often over-taxed. Frequent repetition of this will by degrees stretch and dilate the parts, until at length a sudden effort will thrust the viscus lying next the weak point among the structures forming the wall, or through them, so as to form a subcutaneous tumor.

The viscera usually thus protruding, are those which lie loose and freely moveable in the cavity—viz., the intestines and omentum; but sometimes the bladder, or an ovary, may be found in the tumor. The consequences may be so slight as to be overlooked by the patient, because it is possible for the functions of the part to continue to be regularly performed, notwithstanding its displacement; but, on the other hand, they may be so severe as to prove speedily fatal if these functions are interrupted. If a viscus lie freely in the hernial tumor, and admit of being replaced by making pressure on its exterior or otherwise, it will transmit the fæculent matters as well as if it remained within the abdomen, and the hernia is then called a *reducible* one. If there be little or no obstacle to the performance of its office, and yet it cannot be returned into the abdomen, in consequence of adherences which it has contracted to the wall of the new cavity in which it lies, the hernia is termed *irreducible*. But when the function of the protruded organ is completely arrested, and the circulation through it is obstructed by a constriction of the passage through which it has escaped, the hernia is said to be *strangulated*, and the danger to life is imminent as long as this condition remains. A hernia may exist for years without any strangulation taking place, and, provided proper precautions be observed, may be borne with impunity throughout life; but accident or unforeseen causes may at any time occasion strangulation, and put a speedy termination to life.

The subject of abdominal herniæ has received extreme attention, and the most ample illustration at the hands of modern surgeons; and the beneficial results flowing from their labours in this important field are among the greatest triumphs which science has achieved. The anatomical construction of the abdominal walls, particularly at the points where herniæ are prone to occur, and the changes which they undergo by the presence of protrusions of this description, have been studied and described with the utmost precision and truth; while, from the knowledge thus gained, valuable practical rules have been deduced, which have greatly diminished the mortality from this very common disease. The limits prescribed to us will only allow of our touching, in a summary manner, on the general features of this extremely important subject, for a fuller account of which we would refer the reader to the classical works of Scarpa and Astley Cooper.

The viscera floating in the abdominal cavity are covered by the smooth and shining serous membrane, termed the peritoneum, which is reflected from them to line the abdominal walls, these layers being respectively styled the *visceral* and the *parietal*. Now, as the parietal layer passes over the weak points through which the viscera protrude, and is a very extensible tissue, it is pushed before them as they make their road outwards, and becomes expanded by them, and converted into a bag, in which they lie free, as they did before in the abdominal cavity. This bag is called the *hernial sac*: it consists of a process of peritoneum. Having got beyond the narrow orifice of exit, the viscera have room to expand, and they dilate the sac, leaving it narrow near the orifice, which is termed its neck. The peritoneum is attached to the tendinous and muscular structures of the parietes by a lamina of dense and very elastic fibrous tissue, which at the lower part of the abdomen, where hernia usually occurs, is considerably stronger than elsewhere, and constitutes a very distinct proper membrane, termed in front *fascia transversalis*, and behind *fascia iliaca*, from the muscles of those names on which it respectively rests. This fascia is pushed before the peritoneum in all herniæ, and becomes a covering immediately investing the hernial sac. It is more distinct in some varieties than in others, and in old than in recent herniæ, from the thickening it gradually undergoes by pressure and irritation. It may be termed, in all cases, the *fascia propria*. The other coverings of hernial tumors vary, and must be spoken of under separate heads.

In some rare instances there is a hernia with an incomplete sac, the protruded viscus having, in its natural situation within the abdomen, but a partial investment of the serous membrane. Thus the cœcum, as it lies in the iliac fossa, has no serous coat behind, but adheres by cellular tissue to the iliac fascia; and when it slides out of the abdomen, it remains attached in the same way by its posterior surface, and the sac is deficient there. A similar condition usually exists when the bladder protrudes.

The size of herniæ is liable to the greatest variety: some are so diminutive as to implicate only a part of the circumference of the small intestine, and to entirely escape detection; while others may be so capacious as to comprehend, in their ample dimensions, almost the whole of the abdominal contents. Small herniæ are more dangerous than large ones, because they are more apt to become strangulated, the neck of the sac being very narrow, and because they may be so easily overlooked.

Herniæ that pass out above Poupart's (or Fallopius') ligament, in connexion with the inguinal canal, and the apertures provided for the spermatic cord and its attendant vessels, are styled *inguinal*, and are the most common of all. When they are situate below Poupart's ligament, and bulge into the thigh, they are styled *femoral* or *crural*: these stand next in the order of frequency. Those emerging at the umbilicus are named *umbilical*; and if at any other part of the anterior wall, the general title of *ventral* is assigned to them. There are also *diaphragmatic*, *perineal*, *vaginal*, *obturator*, and *sciatic* herniæ, which receive their several designations from their points of eruption, and are all too rare to deserve more than a passing allusion in this place. Our principal observations will be directed to the inguinal and femoral varieties, as being by far the most important.

The inguinal canal is a narrow passage situated obliquely between the layers of the abdominal muscles, immediately above Poupart's ligament, and taking the sloping direction of that structure. It is the natural way down which the spermatic cord in the male, and the round ligament of the uterus in the female, take their course out of the abdomen—we mean, out of the fascia transversalis, and the muscular parietes of the cavity, and not out of the peritoneum, which is entire, and has no aperture at that part, but covers over that spot as it does every other. This canal is not a tube, but an interval between certain flat muscles, bounded below by Poupart's ligament, which forms for it a kind of grooved floor, on which the contained structures rest. Its deep orifice is placed further from the middle line of the body, and rather higher up than the outer one; and both orifices are termed *rings*, inappropriately enough. The deep or internal ring is opposite the centre of Poupart's ligament, and just above the external iliac artery,

Surgery.
Inguinal hernia.

which at that part gives off the epigastric artery, a vessel of considerable size, that, after its origin, takes an upward course on the *inner* side of the ring towards the epigastrium, to supply the rectus muscle. The vas deferens (or the round ligament of the uterus, as the case may be), coming up out of the pelvis, crosses over the external iliac artery just above the epigastric vessels, and is thus, of course, brought to the outer side of the latter. It then changes its direction, curves round the epigastric artery at or near its root, and enters the inguinal canal, thus getting immediately in front of that vessel. This arrangement is constant, and most important in reference to the question of making incisions for the dilatation of the internal ring in cases of stricture, so as not to wound the epigastric artery. The older surgeons, when they ventured to operate at all, did so doubtingly and with a dread of hemorrhage, which they did not know how to avoid nor how to arrest; but the surgeon now possesses a cardinal rule, which cannot fail to ensure immunity from so dreadful an occurrence. In the male the spermatic artery and veins descend along the loin, towards the internal ring, and then, after passing a little way upon the external iliac artery, meet the vas deferens on the outer side of the epigastric, and join it in its further course in the canal. They together form the spermatic cord, and are connected by areolar tissue. Ere they unite, the constituents of the cord are close to the peritoneum, between that membrane and the fascial tunic that invests it, and already spoken of. On uniting at the ring, and descending along the canal, they carry with them a funnel-shaped process or prolongation of this fascia, and do not burst through it: so that the cord in the inguinal canal is immediately covered by a fascia derived from the fascia transversalis, and called the internal spermatic fascia. Directly over the upper orifice of the inguinal canal arch the lower fibres of the internal oblique, and transversalis muscles of the abdomen as they leave their origin from the middle of Poupart's ligament; and having passed over the cord, they dip down behind it in the form of a thin tendinous sheet, and are then attached to the brim of the pelvis and crest of the os pubis, forming the posterior wall of the canal. Towards the internal ring, however, the back part of the canal is formed solely by the fascia transversalis. The cord lying in front of this tendinous sheet is covered over by a series of muscular fasciculi arising from Poupart's ligament, and called the cremaster. These pass down upon it to the scrotum, and, forming successive loops, return to the canal behind it, to be inserted into the pubis. They constitute an investment to the cord, separated from it only by the fascia spermatica interna already mentioned. On the cord thus covered rests the flat tendon of the external oblique muscle of the abdomen, of which Poupart's ligament is, in a great measure, the lower boundary. This tendon, therefore, forms the anterior wall of the canal, and the passage lies between the internal and external abdominal muscles. The outer orifice, or the external ring, often called *the* abdominal ring, is formed by the tendinous bands opening out to allow the cord to pass. Where the bands begin to separate, they are bound together by arched fibres (inter-columnar fascia), and they then diverge to two points of bone about an inch apart, the angle and the spine of the pubes. Thus the external ring is triangular, and cannot be contracted by any muscular action. This ring is covered over by the superficial fascia of the abdomen, which adheres to its borders, and sends down from them upon the cord as it emerges, a fibro-cellular covering, mingled with some of the inter-columnar fascia, and called the external spermatic fascia. This rests upon the cremaster. In the female the cremaster does not exist, and this fascia accompanies the round ligament to the fibrous structure over the pubes, where it is lost.

Varieties.

There are four varieties of inguinal hernia. In the first, the protrusion takes the course of the cord, and has precisely the same coverings as far down as it extends: this is *oblique* inguinal hernia, and is of all the most common. The spermatic vessels are behind the sac, and the neck of the sac is at the internal abdominal ring. The second bursts through the transversalis fascia, and the conjoined tendons of the internal oblique and transversalis muscles, and enters the canal opposite the external ring, after which it passes through that ring. Its coverings differ: it has no investment from the cremaster, which remains upon the cord behind and to the outer side of the hernial sac. This is *direct* inguinal hernia. The third is a sub-variety of the first, and is called the *congenital* hernia. In the early fœtus the testis, with its vessels, is placed within the abdomen on the psoas muscle, below the kidney; and it is gradually brought down into the scrotum about the period of birth, by a muscular structure, styled the gubernaculum testis. While in the abdomen, its front and sides receive a covering from the general expanse of peritoneum, and as it descends through the inguinal canal it carries down this covering, and drags down the peritoneum in the form of a tubular prolongation. This tube usually becomes obliterated, detaching the serous covering of the testis (now tunica vaginalis testis) from the peritoneum: but occasionally the communication between the two remains open, in which case any of the viscera may descend into the tunica vaginalis as into a hernial sac. This form of hernia commonly occurs in early life, but it may present itself for the first time at as late an age as thirty, if the tubular process have been previously very narrow, and have been then suddenly dilated by unaccustomed pressure on the viscera. Its nature can only be determined with certainty by finding the testis in the sac at the time of operation. The fourth, or *encysted* hernia, is rare, and consists in the sac descending behind the tunica vaginalis, which in such cases contains fluid.

Femoral hernia.

Femoral hernia is situated in the upper and front part of the thigh, below the inner extremity of Poupart's ligament. It protrudes through the crural ring, an aperture behind Poupart's ligament, in front of the os pubis, to the inner side of the femoral vein, and to the outer side of Gimbernat's ligament. This aperture is covered over by the transversalis fascia dipping into the thigh upon the femoral vessels to form their sheath. It is perforated by a number of large holes, for the passage of lymphatics from the inguinal glands, and often contains one of these glands. By these circumstances it is rendered a weak support against pressure from within, and where the arch of the pubes is ample, and the aperture wide, as in women, it very commonly proves incompetent to retain the viscera, and they bulge through it on any unusual muscular effort. Immediately below the ring, the fascia lata of the thigh, a dense aponeurosis which invests the muscles, presents a peculiar arrangement, to allow of communications between the vessels, on the superficial and deep surfaces

Surgery. Femoral hernia.

of it. The saphenic vein, which runs up the inner side of the member in the subcutaneous texture, dips in about an inch and a half below the crural ring to join the great femoral vein, which pursues its course underneath the fascia lata. This latter structure is thus divided into two regions—an outer or iliac, and an inner or pubic. The former passes over the vessels, and is united to Poupart's ligament, sending a narrow triangular process (falciform), that comes to a point near the spine of the pubes: the latter dips under the femoral vessels. Thus a narrow slit exists in the fascia lata, just below the crural ring, and reaching as far as the saphenous opening. Femoral hernia, protruding through this ring, has first a covering from the fascia transversalis; then at once pushing aside the gland and lymphatic vessels, comes into the subcutaneous fascia that lies in the slit, and which is here thick, and separated into many laminæ by fat, glands, and small vessels, and hence termed *cribriform.* It distends this over it, and then is subcutaneous.

Femoral hernia bulges equally in all directions from the position of the crural ring, where its root or neck is situated. If large, it mounts over Poupart's ligament, but can be distinguished from inguinal by our being able to move it downwards below that structure, while the inguinal varieties, though they descend into the scrotum, yet have their root above Poupart's ligament. The spine of the pubis, being a subcutaneous bony tubercle, is the best guide, in circumstances of doubt, to the exact position of Poupart's ligament. It is of the utmost importance to distinguish these two forms from one another, both for our guidance during attempts at reduction, and particularly during the operation, should that proceeding become necessary.

Hernia is apt to be mistaken for various other affections, especially in the region of the groin. Some cases are essentially obscure. One great characteristic of a hernial tumor is its disappearing entirely under pressure; but this is wanting in irreducible and strangulated herniæ; most herniæ have an elastic, soft feel; but strangulated ones are generally very firm, especially if small. Hernia are always fixed deeply to the point of emergence; but other tumors may have a similar deep attachment. But under differing circumstances, various accessory symptoms will probably arise, which will aid the diagnosis. Such are interruption to the functions of the abdominal viscera, and many others.

When strangulation occurs in a hernia, the patient is at once placed in a condition of great danger. The causes of strangulation are usually sudden exertions of the body, in which the trunk has to be fixed by a great muscular effort, as in lifting heavy weights; and occasionally, distension of intestine already protruded, by flatus or fæculent matters. The seat of stricture is at the neck of the sac, that is, either at the internal or at the femoral ring, or, in direct inguinal hernia, at the conjoined tendons. The neck of the sac itself may form the constriction, for it becomes dense and thickened by age, and remains elastic, allowing of sudden distension, but returning to its original size when the pressure is removed. All these circumstances are of great consequence in the proper treatment of the disease. The symptoms of strangulated hernia are to be distinguished into two kinds,—those arising from mechanical impediment to the natural functions of the incarcerated viscera, and those resulting from congestion and inflammation. Among the former are colic, dragging pain in the belly, obstinate constipation, followed by vomiting, obstinate and severe, first of the contents of the stomach itself, then of bile, and the matters contained in the parts of the intestine above the hernia, or as far down as the valve between the small and large gut; for nothing can pass upwards through that valve. With these are great despondency, anxiety, and tormina, and the pulse is small and rapid. The hernial tumor itself is the seat of great pain, stretching towards the back; it is tender, swollen, and hard, from the inflammatory action that supervenes in the intestine and the sac, and the consequent suffusion of serum. If nothing be done to relieve the stricture, the intestine mortifies, inflammation spreads to the peritoneum, with the symptoms belonging to that affection, and the patient, except in rare instances, perishes. Sometimes the gangrene is confined to the strangulated portion, and lymph is effused, which glues together the surrounding viscera, shutting off the disorganized part from the rest of the peritoneum. The dead part, on separating, may then be carried down the canal and be evacuated by stool, while the continuity of the tube is restored, at first through the cavity formed by the slough, and, finally, by the contraction and healing of this, and by the approximation and union of the ends of the remaining sound intestine. These latter phenomena may occur with or without the escape of fæces outwards, by a slough over the hernia, forming an aperture called an artificial anus; but they are too uncommon to be other than exceptions to the general fatal result, and do not influence the practice of the surgeon in strangulated herniæ in the slightest degree. This reparative power of nature has, however, been studied and turned to great account by modern surgeons in the treatment of wounds of the intestine.

Surgery. Strangulated hernia.

When the symptoms of strangulation supervene, all the efforts of the surgeon are at first directed to return the part into the abdomen. Pressure with the fingers, technically called the *taxis*, aided by suitable posture, and by the knowledge of the anatomy of the parts will frequently succeed, if used early, and it may be seconded by venæsection, the warm bath, the application of cold to the tumor, and the exhibition of enemata of cold water, or of some stimulating or narcotic substance. If these means fail, the operation of dividing the stricture should be resorted to. In young persons, where the symptoms are violent, no time is to be lost, but in old subjects, who have suffered from hernia long, where the sac and its neck are long, and where the symptoms have been occasioned by flatus or fæcal accumulation, more delay may be admitted of, and less summary measures be pursued.

The operation being determined on, the patient is placed on his back, and an incision is carried through the skin on the tumor, sufficiently large to expose its interior, and to give room for the surgeon's fingers to readily reach its neck. In inguinal herniæ this is usually made straight, but in the crural variety the object is best answered by making it ⊥-shaped. The several layers are divided with care, either by using an ordinary forceps and scalpel, or by insinuating a grooved director under each, and slitting them up with a blunt-pointed bistoury. The sac is generally known by its dense and bluish aspect, and on being punctured, in most cases gives issue to more or less serum that has exuded from the congested bowel within. The sac being now freely opened, the operator proceeds to examine the nature

and state of its contents. There may be omentum or intestine, or both, in which last case the omentum lies in front so as to conceal the gut. These structures will present various appearances, according to the tightness and duration of the stricture, and the amount of inflammation that has supervened. A dark livid colour of the intestine is to be expected, as the necessary consequence of the turgidity of its vessels; and if not intermingled with greenish half-flaccid spots, which denote gangrene, is not to be regarded as itself an unfavourable sign, and the stricture is at once to be relieved. This is to be effected by passing the finger, or, if that be impracticable, a deeply-grooved and winged director within the neck of the sac, and dividing it to a slight extent. If it be an oblique inguinal hernia, the direction of the knife must be upwards and a little outwards, to avoid wounding the epigastric artery; if a direct inguinal hernia, it must be carried upwards and inwards, for the same reason, and if a femoral one, directly upwards. The general rule laid down by Sir A. Cooper, of cutting directly upwards in all instances, is plain and easily remembered, and, with common care, cannot fail to be successful. The protruded part is then to be returned into the abdominal cavity, the integuments brought together by sutures, and a light compress placed over the part to prevent a recurrence of the protrusion.

If the bowel found in the hernial sac be already in a gangrenous state, it would be unsafe to return it, because its contents would in all probability escape into the peritoneum before the neighbouring parts of that membrane had been glued together by lymph. It must therefore be left in the sac after the stricture is divided, and an incision may be made through the sphacelated spot to give vent to the accumulated matters; a proceeding frequently attended by almost instantaneous relief. The subsequent progress of the artificial anus, thus established, is various, and depends much on the size of the orifice, and the position of the intestine in its vicinity. If small, it will give issue only to a part of the contents, and by its gradual contraction, aided by moderate pressure, will at length cause them all to pass along by the natural channel; after which the external orifice may close. When the slough has occurred at the convexity of a large knuckle, the two sides of the knuckle lie alongside and open together, and between them is a septum, formed by their coats, and which are more or less adherent to one another. This septum prevents the fæces from entering the lower orifice; and it becomes a great object to cut it through, so as to make the two pieces of intestine communicate deep in the wound and within the abdominal walls. For this purpose Dupuytren invented an instrument, the blades of which are passed up the gut on each side of the septum, and are then forcibly brought together, so as to compress and cut through the septum, without laying open the peritoneum. For this cavity, if it enter the septum, becomes obliterated by inflammation before the septum is destroyed.

It may happen that the intestine adheres to the sac by bands, the product of former inflammation. If these are few they are to be divided; but if the adhesion be extensive, the intestine must be allowed to remain in its place after the stricture has been relieved. The immediate effects of the operation are the same as they would have been had the protruded viscus been returned to the abdomen; but there is of course more danger for the future. When omentum occupies the sac, it is often doubtful how it should be treated. If, as often in old cases, it is thickened and indurated, it is to be cut off near the neck of the sac, and the bleeding vessels tied. Before dividing it, the surgeon must have it properly secured above, or it is liable to slip into the abdomen before the hemorrhage is arrested. This plan of cutting away diseased omentum is far better than that of strangulating it by the ligature. When the omentum seems healthy it may be pushed back into its site; but, under some circumstances, it may be advisable to leave it in the neck of the sac to become adherent, and serve as a plug to prevent future escape of the abdominal contents.

We have described the operation usually practised. There is another which consists in a division of the stricture without opening the sac, and which was proposed in order to avoid the untoward consequences which general opinion attributes in many instances to penetrating wounds of the serous membrane. The steps of the ordinary operation are performed until the sac is exposed, when the surgeon insinuates a director between the neck of the sac and the adjacent structures, and divides these with a bistoury in the usual direction. The taxis is then applied on the outside of the sac, as if no wound had been made. This operation is applicable to many recent herniæ, where there may be no apprehension of sphacelus of the intestine, and the most fear of serous inflammation. It must be regarded as an admirable improvement, calculated to diminish the mortality of the disease. It is no argument against it that the stricture is sometimes formed by the neck of the sac itself, as the old operation can be at once substituted for this one, when it has been found unavailing.

We have now described the treatment to be pursued in the case of a strangulated hernia. This treatment is the result of much thought and careful research among modern surgeons; and judicious and rational as it is, it must be regarded as at best a kind of *dernier ressort*, attended with grave chances against a favourable issue. This will show the extreme importance of noting the predisposing and exciting causes of herniæ, and of averting in time the disastrous results which too often inevitably follow strangulation. Trusses of various kinds have been invented for keeping up a continuous pressure upon the skin over the aperture through which protrusion occurs, and are among the most valuable apparatus of surgery. They consist usually of a pad, fixed by a steel spring, which passes horizontally round the body, and is generally kept in place by a tape under the perinæum. They should in all cases be adapted to the individual by a surgeon who understands the anatomy of the parts, and the precise direction in which pressure is to be made. Many trusses are worse than useless, by allowing the hernia to descend behind them, and to become subjected to their pressure. It is obvious that a person liable to hernia should abstain cautiously from everything that can occasion disorder of his alimentary canal; should never allow himself to be constipated, and should avoid all exertion of a violent and sudden kind. Trusses, if worn for two or three years after the first appearance of a hernia, will generally cause the complete cure of it; but if their use be not commenced for some time after the descent, there is less hope of this favourable result, and they must be continued many years, or throughout life.

Much more might be added on various points of this important subject; but we must be content with the

rapid sketch of its general bearings, to which our limits have confined us.

Of Aneurism.

Aneurism.

Aneurism is a disease of the very first consequence to the surgeon, because if unchecked it is necessarily fatal, and yet it may very often be cured by timely interference. Everything will depend on his judgment, promptitude, and skill. It consists in a cavity containing blood, and communicating with an artery.

True aneurisms are those formed of the dilated coats of the vessel; the false are formed wholly or in part by the surrounding textures, often lined by lymph. True aneurisms are the result of disease; the false often follow from wounds inflicted on the arterial coats. "Aneurism in its worst shape," says a great authority, "is a terrific disease. Aneurism of the aorta, for example, when occupying the chest, and pressing on its contents, the tumor pulsating with a blow like that of an engine, then rising visibly, gradually increasing, and suddenly bursting with a force that sends the blood to the ceiling! Again, in the extremities the tumor is with equal certainty fatal, if left without timely aid, and thereby imposes on the surgeon an extraordinary responsibility." If the disease have an external position, it appears as a tumor in connexion with one of the great arterial trunks, usually pulsating synchronously with the strokes of the heart, and having a soft compressible feel if it be filled with fluid blood, but firmer if there be much coagulum in the sac. There is generally an audible rush with each pulse, heard by applying the ear over the swelling; and on laying the hand upon it we feel a swell or distension, not only upwards, but in every direction, and can press out the blood more or less readily. Such are the marks of an aneurism in its earlier stage, and they may all be in some degree counterfeited by other diseases. A tumor adherent to an artery may derive pulsation from it; and if it be an encysted one, it may possess something of the swell of an aneurism, and by its compression of the vessel it may occasion the blowing or rushing sound (termed *bruit de soufflet*); but in general such affections may be distinguished from aneurism. It often happens that such tumors can be elevated a little from the artery by the fingers, and then the pulsation is found to have ceased; a characteristic sign. We shall not attempt to define minutely the distinctions of aneurisms, but content ourselves, as on other occasions, with a sketch of the main features of the subject.

The elastic or proper coat of the arteries is liable to a slow alteration of structure, whereby it is deprived of its toughness and elasticity, and suffers gradual dilatation by the force of the blood within it. This disease may exist without aneurism, however, provided the circulation is not very active, as may be constantly seen in old persons; but if it comes on early in life or in the vigour of manhood, while the heart beats with strength and frequently with vehemence, it makes the vessel unable to resist distension. Some arteries are particularly liable to dragging from their position, such as the popliteal and the axillary, and it would seem as though such arteries were more prone either to take on the morbid action or to suffer from its presence than others, for aneurisms of the extremities most commonly occur near the joints. When the dilatation has proceeded to some extent the coats of the artery give way, and the remainder of the sac comes to be formed of the neighbouring structures—bone, ligament, muscle, nerve, or within the great cavities of the trunk by some or other of the viscera—as the lungs. When an aneurism results from a wound or rupture of an artery, the blood is shed into the surrounding parts, and a recess among them is formed by degrees, partly by the coagulation of the blood in the meshes of the cellular tissue, and partly by the effusion of coagulable lymph from the capillaries. The inner surface of this *sac* grows smooth, and seems at length continuous with that of the artery, but blood is deposited upon it in layers, and always tends, more or less efficiently, to its obliteration. It has been observed that these layers sometimes encroach far on the cavity of the aneurism, and reduce its dimensions within very narrow limits, and in some very rare instances they have completely filled it, and thus spontaneously cured the disease. This fact is one of great significance—this tendency to coagulation of the blood that fills the sac, and which, be it remembered, is, like that within the vessel itself, in constant motion. That the blood should preserve its fluidity as long as it remains within its natural channels, and coagulate on its withdrawal from them, is one of the most wonderful provisions of the animal economy, and seems to depend simply on the lining of epithelium within the arteries and veins which we have before mentioned. This lining does not exist within aneurismal sacs, and thus coagulum is deposited there, notwithstanding the rush of blood through them.

The coagulation of the blood within the sac is also favoured by the slowness of its passage through it, and it would speedily obliterate the cavity could its motion be altogether stopped. There is therefore one principle to guide our efforts to promote this occurrence, and the carrying out of this in practice is called the method of Valsalva, who was the preceptor of Morgagni, and the first to inculcate it. The patient is to be starved almost to death, and depressing remedies given, so that the circulation may be as languid as is compatible with life, and compresses and cold are to be applied to the tumor, and if possible to the whole region where it is situate. This treatment is to be continued for weeks or months. It may be fairly questioned whether acting on the heart by digitalis or tartar-emetic, with perfect rest, and the use of the local measures above specified be not likely to be rather seconded than contravened by an animal diet, administered with a view to render the fibrine more abundant and more coagulable. In many large aneurisms of the chest, where the method of Valsalva has been the only available one, it has had the undoubted effect of retarding, and in some instances even of curing, this formidable affection.

But in the infinite majority of cases of aneurism this treatment is found to be of no real service in checking the progress of the disease. The sac increases in size, the structures in the vicinity are pushed aside or absorbed, until the sac gives way, blood is thrown among the textures, or it escapes into a cavity or through a slough of the skin, and the patient perishes in an instant. If the surrounding parts are infiltrated with blood inflammation commonly supervenes, and generally leaves no other chance of recovery than by amputation, if indeed that be practicable. To prevent these disastrous consequences an operation is to be performed, which modern surgery has introduced, and which is applicable to almost all aneurisms but those of the trunk;

the artery is to be tied and obliterated between the disease and the heart. The idea of an obliteration of the main artery appalled the older surgeons, because they were not aware of the free communications everywhere existing between neighbouring branches, and which are wholly sufficient, after the main current is stopped, to carry along the blood required for the nutrition of the parts below. This anastomosis, as it is termed, of the collateral channels, is shown by the bleeding from both upper and lower orifices of a divided artery, and makes the surgeon fearless in applying a ligature to both. When a ligature is placed on the artery leading to an aneurism, the current of blood to the sac, therefore, is not quite stopped, but by becoming more circuitous its force is broken as it traverses the small vessels, and this gives the desired opportunity for coagulation to take place within the sac. After such an operation the sac soon beats as before, and the limb becomes warm, but by degrees the pulsations in the sac grow fainter and the tumor more solid, until the mass of coagulum is sufficiently large and firm to resist further distension, even though it do not quite fill the sac. But in general not only is the cavity impacted by it, but the artery is obstructed permanently near the orifice of communication by an extension of the clot into it. An admirable proof of the current continuing in the artery below the ligature is the fact, that a part of that vessel between the ligature and the sac may remain permanently open, receiving and transmitting blood through small branches. This often occurs where the artery is tied in the thigh for aneurism in the ham, the distance between the two points being greater than in other situations. This operation, which we owe to John Hunter, is one of the greatest improvements of modern surgery. It would appear that its author considered the great advantage of tying the vessel at a distance from the aneurism was, that its coats there were more likely to be healthy, and therefore to escape ulceration and secondary hæmorrhage. It is attended, however, with the further advantage of a small wound, and that at a distance from the seat of disease, so that inflammation is less likely to occur and to spread dangerously if it do supervene. It is clear that the extensive inflammation that used to follow the sanguinary operation of the old surgeons, of laying open the entire sac by a large incision, sponging out the blood, and tying the bleeding orifice in the vessel, was a frequent cause of the gangrene that so often made this proceeding the terrible forerunner of death.

The modern principle of cure has now been carried into practice in the case of all the principal arteries of the head, neck, and extremities, and even on the aorta itself, and its merits thus sifted in a great variety of instances. The result is, that if performed sufficiently early in the course of the disease, it is the safest and most certain curative measure that can be adopted in aneurisms of the arteries in the limbs, and of the carotids and their branches. The external iliac artery has been frequently tied with success for aneurism of the femoral, since Mr. Abernethy's first operation in 1796, and the internal and common iliacs in a few examples. The subclavian has also been tied in the outer and middle portions of its course for axillary aneurism, and in its inner part for aneurism of the vessel outside the scalenus muscle, as well as distally with the carotid, for aneurism of the innominata. The operation in this latter situation has never yet succeeded; the patients in whom it has been tried have lived long enough to prove that circulation was restored in the arm by collateral channels, but they have uniformly died previous to the separation of the ligature, either from inflammation within the thorax or from secondary hæmorrhage, arising from the failure of the reparative process in the artery. The same result has followed in sundry operations on the arteria innominata, and it appears doubtful whether this vessel or the subclavian in the first part of its course will ever be tied with success. Their very large size, and, in the latter case, the origin of several large branches near the point of ligature, seem to form obstacles too great to be overcome. Even the aorta itself has been tied in three instances, but with uniform ill success. John Bell had shown that this great trunk was sometimes obstructed by coagulum, or contracted, so as to give no passage to the blood, and yet that the inosculations between various branches above and below the impervious point were quite capacious, and free enough to convey the blood to the lower limbs; and Sir A. Cooper was so bold as to cut down through the belly and pass a ligature round this vessel in a case of iliac aneurism. The result showed that the circulation was not interrupted, though the patient died in a few hours.

The above facts abundantly testify to the inadequacy of this operation in certain cases. In these, however, the artery may sometimes be tied beyond the tumor, *i. e.*, further from the heart. This operation, proposed by Brasdor, was brought into notice by Mr. Wardrop. It has succeeded in a few cases of aneurism of the great arteries at the root of the neck. It is not, of course, so efficient in diminishing the rush of blood into the aneurismal sac as the operation of Hunter; but as it is applicable in some instances from which experience has excluded the other, it must be regarded as an important step in the surgical treatment of this disease.

We may here advert to the operation itself. The cutting down on a great artery and placing a ligature upon it, is a proceeding justly reckoned among the capital operations of surgery. The surgeon has not only to be accurately acquainted with the anatomical position and connexions of all the principal arteries, but must understand the process by which nature effects the permanent obliteration of the vessel. If ignorant on these points, he may easily sacrifice the life confided to his skill. The several textures over an artery having been cut through or turned aside, the cellular sheath in which it is enveloped is to be opened with a blunt-pointed instrument, as a probe or director, and the artery bared all round to an extent sufficient to admit the curved blunt needle carrying the thread. This needle itself is as good an instrument as can be employed for effecting this. The sheath once opened, the thread is easily slipped round the vessel; but if dense cellular membrane is left adhering to the artery, the needle is apt to wander from its course, to pierce the contiguous vein, or to encircle neighbouring nerves. The artery is to be separated from its sheath only as much as may be absolutely required for the passing of the thread, in order that the minute vessels that will have to conduct the reparative process may be preserved entire. For the same reason the thread should be round and not too thick, and it should be tied tightly, that it may crush the proper arterial coat, and be detached early. The usual period for its separation is from the fifteenth to the twenty-fifth day.

Surgery. Aneurism.

The cure of aneurism by the operation of Hunter, although it is that which every surgeon is bound to attempt in the vast majority of cases, yet is attended with some dangers, and may possibly accelerate a fatal result. Gangrene of the limb comes on in a few instances, and secondary hæmorrhage may occur from a failure of the healing process in the artery. These untoward events will depend on a variety of collateral circumstances, and may be frequently obviated by proper precautions, and on the whole they form no argument against the performance of the Hunterian operation in ordinary cases.

We have now spoken of the treatment of spontaneous aneurisms; it remains for us to say a few words on those aneurisms that result from injury to the arterial coats.

Aneurism at the bend of the elbow, from a wound of the brachial artery, inflicted by the lancet during venæsection, was formerly a disease more common than in the present day, when those who have this little operation to perform are better instructed in anatomy, and know how to treat a puncture of the artery if it occur. The veins proper to be opened in phlebotomy lie in the cellular membrane and fat subjacent to the skin, and termed superficial fascia. The artery runs below, and separated from them by the strong sheet of fibrous structure which invests and binds down the muscles, and which is called the deep fascia; so that the lancet must transfix the vein and the deep fascia before it can enter the artery. A most important rule, therefore, in venæsection is to distend the vein previously, and to puncture only its superficial wall. But occasionally the artery divides above the elbow into the two chief arteries of the fore arm, in which case one of these may pass down in the superficial fascia, with the veins, and be more liable to injury. Hence the surgeon should always endeavour, before thrusting in his lancet, to ascertain the precise position of the artery by feeling its pulsations. A puncture of the artery is at once known by the spirting forth of scarlet blood in furious jets, along with the dark even stream of purple venous blood. Seeing this, the surgeon must consider the direction of the puncture in relation to that of the vessel, and what may be its size. If very small, he should at once compress the part firmly, and having stopped the flow, should then bandage the entire limb from the fingers upwards, and enjoin the most absolute rest. In this way a few days will sometimes be sufficient to ensure a re-union of the wound without further bad consequences. But if the bleeding orifice be large, if it probably traverse more than a fourth part of the diameter of the vessel, these means are not to be trusted to, but an incision must be made down to the bleeding point, and the vessel secured with a ligature immediately above and below it. The after-treatment will be that of wounded arteries generally. When these means fail, or are not pursued, the patient may die of hæmorrhage primary or secondary, or if the external wound be healed rapidly ere that in the artery is closed, the blood may force itself from the artery through the contiguous orifice in the vein, and thus form a permanent channel of communication between them, which, if direct, is termed an *aneurismal varix*, the vein becoming dilated; but if through the medium of an aneurismal pouch established between the two vessels, receives the name of *varicose aneurism*. But more commonly the orifice in the vein is closed, and the pouch formed is an aneurism with walls constituted of the neighbouring structures lined by lymph and fibrine. A similar result may follow wounds of any other large artery of the body.

Surgery. Aneurism.

Cases of communication between the artery and vein are not to be interfered with unless great inconvenience results, or they tend to increase rapidly. The only operation admissible, where the vein is implicated, is to take up the artery above and below the wound. Hunter's operation will not succeed, but produce mortification of the arm; for the collateral circulation cannot be established through the capillaries, when there exists so direct a communication between the artery and vein. It previously required all the force of the arterial pulse to drive the blood through the capillaries of the limb below the orifice. In the false aneurism from a wounded artery, the aneurism may be opened and the vessel tied above and below; or Hunter's operation may be practised. In general the former course will be preferable. A tourniquet is placed on the limb, the sac is laid freely open, the coagula sponged out, and a probe set in the orifice, as it spouts forth its blood when the tourniquet is unscrewed. The threads are then passed round the vessel, taking care that its coats are not detached more than necessary from the sheath. The sac will suppurate and close up; but the motions of the joint will remain constrained if the tumor had attained a large size.

Diseases of the Eye.

Diseases of the eye.

The eye, with its appendages, is subject to numerous diseases, which are especially interesting, on account of the delicacy and importance of the parts concerned, as well as from the fact that we are enabled to see the changes induced by these diseases, and to trace their daily progress with ease and accuracy. We shall consider first the diseases of the eye-lids and lachrymal apparatus, and subsequently those of the eye itself, and of the conjunctiva. Our account of this important class of diseases must necessarily be very brief.

Hordeolum or *stye* is a small painful tumor on the margin of the lid. It arises from obstruction and inflammation of one or more Meibomian follicles. It is best relieved by warm fomentations, and, when it is sufficiently advanced, by a puncture.

Ophthalmia Tarsi is inflammation with disordered secretion of the Meibomian glands. The secretion accumulates during the night, and the edges of the lids become glued together. It occurs in strumous persons, and is often associated with disorder of the digestive organs. It not unfrequently leads to loss of the eye-lashes. The general health must be attended to, and the bowels must be carefully regulated. The best local application is the diluted nitrate of mercury ointment, which may be rubbed on the margins of the lids. *Entropion* denotes an inversion of the eye-lid, and a consequent rubbing of the lashes upon the surface of the eye. This condition keeps up a constant inflammation of the conjunctiva, and an increased flow of tears. The remedies are, to make two perpendicular cuts with scissors through the margin of the lid, or to dissect away entirely the margin of the lid. Another mode consists in cutting an elliptical piece from the skin of the lid; the contraction of the cicatrix counteracts the tendency to inversion.

Ectropion is an eversion of the lid, which most commonly is the result of chronic inflammation and thickening of the conjunctiva; but it is sometimes produced by the contraction of a cicatrix on the cheek. If a thick-

ened state of the conjunctiva be the cause of entropion, we must remove this by the use of stimulating and astringent lotions, or by the application of the sulphate of copper. When it appears to arise from an undue laxity of the entire lid, it has been proposed to remove a triangular piece from the margin of the lid. If caused by a cicatrix on the cheek, the cicatrix must be divided or dissected out.

Lagophthalmia is an inability to close the eye, in consequence, generally, of palsy of the portio-dura, which nerve supplies the orbicularis muscle.

Ptosis is a falling of the upper lid, from palsy of its levator muscle. It is sometimes the precursor of a fit of apoplexy, in other cases it results from palsy of the third nerve, by the pressure of a tumor or some other local cause. The treatment must be conducted with reference to the cause. If it persist after all other means have failed, a portion of skin must he snipped out from under the eye-brows, so that after the contraction of the cicatrix the lid may be raised by the occipito-frontalis.

Closure of the lachrymal puncta occasionally occurs, and produces stillicidium lachrymarum, or a flow of tears over the cheek. The openings may be restored by passing a very fine probe through the puncta. *Inflammation of the lachrymal sac* is known by the formation of a red, tender, and painful tumor by the side of the nose, and beneath the inner angle of the eye. The tears are prevented taking their usual course, and they flow in a constant stream over the cheek. If the inflammation be not subdued, matter forms, and escapes by an opening on the cheek. In some cases the bursting of the abscess is followed by the closure of the orifice and a complete cure; but it more commonly happens that some chronic inflammation remains, the mucous membrane of the sac and of the duct becomes much thickened, the passage of the tears down the duct is completely arrested, a fistulous opening on the cheek remains, and gives exit to the contents of the sac; or when, as sometimes happens, this orifice closes, the tears may be made to regurgitate through the puncta by pressure made upon the sac. In the early stage the object of treatment is to subdue inflammation by the application of leeches and the use of fomentations. If suppuration occur, the matter should be evacuated by a puncture, the sac may then be washed out by an injection of warm water, and afterwards a solution of acetate of lead or sulphate of zinc may be used for the same purpose. If, in consequence of the thickening of the mucous membrane, the nasal duct be obliterated, a silver style must be passed down the duct, the head of the style resting upon the cheek; the tears make their way by the side of the style, and the patient is freed from the annoyance of a constant flow of tears over the cheek. The style must be taken out and cleansed occasionally; the duct is very apt to close if it be left off, and it is generally worn for life.

The conjunctiva is subject to inflammation, which in different cases varies much in degree as well as in its consequences, and in the circumstances under which it occurs.

Catarrhal ophthalmia is that variety of inflammation of the conjunctiva which arises from exposure to cold and wet. It is attended with pain and heat in the eye, and a sensation as if particles of sand or dust were beneath the lid; the conjunctiva is of a scarlet red colour, the vessels are superficial, and can be made to move over the sclerotic. The secretion of the membrane is at first diminished, and there is a sensation of dryness; in the more advanced stages there is an increased mucous discharge, and in severe cases it becomes slightly purulent. The cure may be effected by the application of a few leeches, a calomel purge, followed by a black draught, and a saline diaphoretic. The most efficacious local application is a lotion of nitrate of silver, in the proportion of grs. iv. to ʒ j. of water. The margins of the lids should be smeared with simple ointment, to prevent their adhesion at night.

Chronic inflammation of the conjunctiva is frequently the sequel of the acute; if long continued it produces a granular state of the conjunctiva lining the lids, which acts as a constant source of irritation. This form of the disease is best treated by stimulants, such as the vinum opii, a few drops of which may be put into the eye daily. Blisters behind the ears are occasionally of use. The granular state of the conjunctiva may be removed by the application of the sulphate of copper.

Purulent ophthalmia in children occurs a few days after birth. In some cases it arises, without doubt, from the contact of irritating discharges to which the child is exposed during its passage through the vagina of the mother. In other cases there is no evident vaginal discharge, and we must attribute the disease to exposure to cold and neglect of cleanliness. It is attended with intense redness of the conjunctiva, great swelling of the lids, and a profuse purulent secretion; at the same time the child is restless and feverish. If neglected, it leads to opacity, ulceration, and even sloughing of the cornea; but it generally yields to early and judicious treatment. The bowels should be opened by hyd. c. cretæ with rhubarb; a leech may be applied to each lid, taking care that the bleeding be not too profuse; the eyes must be kept washed and bathed with warm water, and a solution of alum, in the proportion of grs. iv. to ʒ j. water, must be syringed into them twice a day. Purulent ophthalmia in adults is a more formidable disease; it occurs under two forms,—the contagious or Egyptian, and the gonorrhœal ophthalmia. The first form is that which has on some occasions spread very extensively among our armies. The crowding together of a number of men in close and ill-ventilated rooms seems especially favourable for the propagation of this disease, not merely by contact of the purulent secretion, but by infection through the medium of the atmosphere. The gonorrhœal ophthalmia is produced by the contact of the matter of gonorrhœa, and rarely attacks both eyes; it does not differ from the last-mentioned form, except in being more severe and more certainly destructive of the eye. Both these forms of ophthalmia commence with stiffness and a sensation as of a foreign body in the eye, the lids become much swollen, the conjunctiva intensely vascular; the great swelling of this membrane round the cornea is termed chemosis; the secretion is at first scanty, but it soon becomes purulent and very abundant; there are headache and fever. It frequently leads to ulceration of the cornea, and in the most severe cases it extends to the deep tissues, producing suppuration in the globe, sloughing of the cornea, and complete destruction of the eye. In order to arrest the progress of this rapidly destructive disease, blood must be taken from the arm, and from the neighbourhood of the eye by leeches or cupping; the patient must be kept on low diet and in a dark room, and the bowels must be

freely purged. The local application, which, although formidable in appearance, has been attended with most success, is a strong solution of nitrate of silver, or the ointment recommended by Mr. Guthrie; this is composed of grs. x. nitrate of silver to ʒ j. lard, and a piece the size of a pea is to be placed on the surface of the globe twice a day. When the chemosis is excessive, and threatens to obstruct the passage of blood to the cornea, incisions radiating from the cornea should be made down to the sclerotic. After the acute stage is over, blisters may be applied to the nape of the neck and to the temples.

Strumous ophthalmia commonly occurs in children. It is marked by great intolerance of light, not much vascularity of the conjunctiva, but some vessels are seen running towards one or more pustules on the cornea; these pustules generally lead to ulceration of the cornea, and sometimes to perforation, escape of the aqueous humour, and prolapse of the iris. The cicatrization of ulcers on the cornea generally leaves some permanently opaque spots, the slightest of which are called *nebulæ*, and the more considerable opacities have received the name of *leucoma*. A collection of pus between the laminæ of the cornea is called *onyx*, from its resemblance in shape to the white spot at the root of the finger nail. In the treatment of strumous ophthalmia attention must be paid to the general health. The bowels must be carefully regulated, tonics may be given, the application of a few leeches is sometimes useful; blisters to the nape of the neck and to the temples, and a solution of nitrate of silver, or the vinum opii, may be applied to the eye daily. *Inflammation of the sclerotic* is called rheumatic ophthalmia. In this form of inflammation the redness is deep-seated and of a pink hue; the vessels radiate in straight lines from the cornea; there is considerable dimness of sight, and great pain, which is not confined to the eye, but extends to the forehead, and is much aggravated at night. The treatment consists in bleeding and leeches, purgatives and diaphoretics; sometimes calomel and opium; Dover's powders and opiate liniments over the brows to relieve the nocturnal pain. *Inflammation of the iris* is characterized by intolerance of light, dimness of sight, a zone of pink vessels surrounding the cornea; lymph is effused, rendering the fibres of the iris indistinct, and changing its colour; sometimes the lymph is seen in the form of minute drops on the surface of the iris; the pupil becomes small and irregular, and is occasionally completely closed by the effused lymph. Iritis may be the result of a wound, but it generally arises from a syphilitic, gouty, or rheumatic state of the constitution. In the treatment blood must be taken from the arm, or from the neighbourhood of the eye, by leeches or cupping, according to the severity of the case and the strength of the constitution. Calomel and opium must be given to affect the mouth, and thus to promote the absorption of lymph, or to prevent its further effusion. Another important point is to keep the pupil dilated with extract of belladonna, a solution of which should be smeared on the brow or dropped into the eye. Turpentine is a valuable remedy in iritis, and may be used when from any cause mercury is deemed inadmissible. In gouty and rheumatic iritis mercury is less important and less requisite than in the syphilitic form of the disease. When the sight is impaired by closure of the pupil, or by an opacity in the centre of the cornea, an artificial opening may be made in the iris. This may be done by introducing a cutting needle through the cornea and making an incision through the iris; or an incision may be made in the cornea, the iris drawn out with a fine hook, and a portion snipped off; the latter is the preferable mode.

Cataract is an opacity of the crystalline lens, or its capsule. The patient complains of gradually increasing dimness of sight; objects appear to be surrounded with a mist; and if we examine the eye when the pupil is dilated by belladonna, we observe an opaque body, of a grey, blue, or amber tint, behind the iris. Persons who have cataract see better in the evening, or when the pupil is dilated by belladonna. Opacity of the capsule occurs in spots or streaks, with less opaque intervals. Hard lenticular cataract usually occurs in old persons; it is small, and of an amber or grey colour. Soft cataract is more common in children; it is of large size, and of a bluish or pure white colour. Cataract may arise from inflammation consequent on a wound of the lens; in old persons it is generally the result of imperfect nutrition; it is sometimes a congenital malformation. Cataract can be cured by operation only. There are various modes of operating for cataract; extraction is the method which in this country is usually adopted in cases of hard cataract; it has the advantage of removing the disease at once; but on the other hand, it requires considerable skill for its performance, and is attended with the risk of some serious mishaps which the other operations are free from. In the operation for extraction an incision is made across the cornea with a triangular knife; the incision is made close to the margin of the cornea, and thus a flap is made of its inferior half, the aqueous humour escapes, a curette is introduced for the purpose of lacerating the capsule, then by slight pressure on the globe the lens is made to escape. Care must be taken that the vitreous humour does not escape with the lens. After the operation the eye must be bandaged, and the light must be carefully excluded for several days. The patient must be carefully watched, and inflammation is to be subdued by bleeding, leeching, and purging. The operation of depression is performed thus: a couching needle is passed through the outer side of the sclerotic, about two lines behind the margin of the cornea, and a little above the transverse diameter of the eye, so as to avoid the long ciliary artery. It is carried inwards in front of the cataract, and is steadily pressed upon it, so as to carry it downwards out of sight. The needle is then withdrawn. The method of reclination, which consists in turning the lens so as to make its upper margin project backwards into the vitreous humour is seldom performed.

The operation for producing absorption is easily performed, and excites little inflammation, but it requires repetition, and the cure is slow. It is best adapted for soft cataract. The needle is introduced in the same manner as for the last operation, or it may be passed through the cornea; it is then made to lacerate the capsule, and the lens being exposed to the action of the aqueous humour is gradually absorbed. After the operation for cataract the patient must make use of convex glasses to compensate for the loss of the lens.

Glaucoma is a disease which consists in a change in the structure of the hyaloid membrane and of the vitreous humour. It is marked by pain, gradually increasing dimness of vision, and a greenish discoloration

Surgery. Diseases of the eye.

of the pupil. It is but little under the influence of remedies.

Amaurosis signifies an impairment of vision, depending on some change in the retina, optic nerve, or brain. At the commencement of the disease there is usually indistinct vision, objects sometimes appear doubled, or one-half only of an object looked at is seen; or objects may be disfigured or discoloured. Ocular spectra occur in the form of flashes of light, or floating spots, or a coloured network. The iris moves sluggishly, and in the advanced stages is totally motionless; in confirmed amaurosis the patient can distinguish no objects; he has a peculiar fixed vacant stare, and the eye-ball is protruded and motionless.

The causes of amaurosis are numerous and various. It may arise from inflammation of the retina, especially a slow inflammation induced by long-continued exertion of the eye, or exposure to a glaring light. Amaurosis may also be a consequence of organic change, inflammation, concussion, compression from extravasated blood, fractured bones, morbid effusions, tumors, or aneurisms, whether affecting the brain, optic nerves, or eye. Another class of cases are functional, and may result from loss of blood, long-continued lactation, or some other exhausting influence. Some cases appear to be sympathetic of distant irritation, especially of the gastro-intestinal canal. The treatment of amaurosis must be conducted with reference to the cause which has given rise to it. Inflammatory symptoms must be combated by bleeding and the cautious exhibition of mercury. If it can be traced to the action of debilitating circumstances, the administration of tonics, with the use of a generous diet, will be called for. If the amaurosis appear to be sympathetic of irritation in other parts, the source of irritation must, if possible, be removed.

Short sight (*Myopia*) may depend on some vice of original conformation, or it may be induced by the habit of looking closely at very minute objects. It depends on too great a refracting power of the media through which the light has to pass before reaching the retina. This may be obviated by the use of concave glasses.

Longsightedness (*Presbyopia*) depends on a diminished refracting power in the humours; it is one of the results of impaired nutrition consequent on old age. The only remedy is the use of convex glasses.

The eye is sometimes the seat of malignant disease, medullary fungus, or melanosis. These cases are almost invariably fatal; the disease returning even after the extirpation of the eye.

Strabismus, or squinting, consists in the non-correspondence of the optic axes of the eyes. The causes of this affection are various; it is not an unfrequent result of organic disease of the brain. In some cases we find it associated with opacity in the centre of the cornea. In children it is often produced by a habit of voluntarily turning both eyes towards the nose, in imitation of some squinting individual; the muscle which is thus frequently brought into strong voluntary action becomes more powerful than the other muscles, and the squint is rendered permanent. The most common form of strabismus is that in which one or both eyes are directed towards the nose; the outward squint is much less common, but it sometimes occurs in consequence of palsy of the third nerve. When squinting is the result of organic disease of the brain, or of opacity of the cornea, our efforts must be directed towards the removal of that condition of the brain or of the cornea. When it arises from an unnatural contraction of one muscle, or from a want of power in others, benefit is sometimes derived from covering the healthy eye with a bandage, and making the patient use the squinting eye so as to bring into play all its muscles. If this do not succeed, we may divide the tendon of the rectus muscle on that side towards which the eye is unnaturally drawn: the internal rectus is the one which generally requires division, and it may be done either with the scissors, by the help of a hook first passed under the tendon, or with a small curved sharp-pointed bistoury. After the division, the opposing muscle brings the eye into the proper position, the divided ends being separated to a certain extent, and in a short time becoming connected by new tissue, both to one another and to the globe. In some cases the deformity is entirely removed by this operation, but in others the squint returns to some extent, in which case the operation may be repeated on the opposite eye.

Before concluding our sketch it remains for us to say a few words of an important improvement introduced into the practice of surgery within a comparatively recent period—we allude to *lithotrity*. We have already spoken in brief terms of the operation of lithotrity, by which calculi formed in the urinary bladder by a slow deposition of salts from the urine, are extracted by an incision made into that cavity. The various attempts hitherto made to dissolve these concretions by chemical substances, either taken into the system through the stomach, or injected at once into the bladder by the natural outlet, have not been attended with the success which their advocates have anticipated, and although it would be premature to abandon all hopes of success from this mode of treatment, it is certain that the extraction of the stone is at present the only known remedy for this most painful and fatal malady. The operation of cutting, though not unattended with serious danger, yet as now practised by well-informed surgeons, is generally successful in uncomplicated cases, and it has the advantage of being a speedy and effectual cure where it succeeds. But on the other hand, it is an exceedingly painful proceeding, and one which, being accompanied by its peculiar risks of life, is greatly dreaded by patients, and consequently postponed in many instances beyond the period when it might have been performed with good chance of a favourable issue.

The operation of comminuting the stone in the bladder by means of an instrument passed along the urethra was first carried into effect by Civiale, in 1824; but the honour of devising the means appears to be shared by several, among whom may be mentioned the names of Amussat, Leroy, and Heurteloup, in particular. Our own countrymen, however, participated in the merit of having paved the way for the introduction of lithotrity. Various improvements have been since made in the instruments employed, by which greater strength as well as simplicity have been given to them. That now almost exclusively used in this country, and usually known by the name of its inventor, Mr. Weiss, consists of two blades, adapted to one another, and, when closed, resembling in shape the common short-curved sound. These blades slide one upon the other, and on being opened within the bladder may be made to seize the stone, upon which they are then closed. A screw force

Surgery. Lithotrity.

can now be brought to bear upon them, by which the stone is crushed. The jaws of the blades are armed with teeth to prevent the stone from slipping out, and the farther blade is perforated behind the position of the stone, to allow of the fragments falling out previous to the withdrawal of the instrument. For the performance of this operation the patient must be in good general health, the stone of moderate size, the bladder uninflamed and dilatable, the prostate gland unenlarged, and the urethra capacious. The patient is placed on his back, with the pelvis somewhat raised on pillows, to throw the stone towards the superior fundus. The urine is then withdrawn from the cavity and six or eight ounces of water injected to give room for the movements of the instruments, and to avoid risk of injury to the coats of the bladder. On the introduction of the *lithotrite* it is first used as a sound, to ascertain the position of the stone. It is then lowered on one side of the stone, which, on the blades being opened, generally drops between them without difficulty. They are then closed upon it, and carried into the middle of the cavity away from the walls, and the screw is then turned. The resulting fragments may be afterwards seized in a similar way, and further broken, until the whole is so much reduced as to be able to pass out by the natural channel. In the most favourable cases a few sittings are sufficient to accomplish this, and the patient is cured. It scarcely falls within our design to consider the various circumstances which interfere with this happy result, or which sometimes render it impossible of accomplishment. The reader who is desirous of particular information on this subject is referred to the last edition of the excellent treatise of Sir B. Brodie on urinary disorders, where he will find the best statement of the comparative value and several advantages of lithotomy and lithotrity hitherto published.

Surgery. Operations for the cure of deformities.

We may also allude to the operations lately introduced with so much success for curing various deformities, depending on, or complicated with, contractions of muscles or their tendons. The different kinds of club-foot, contracted knees or fingers, and even certain curvatures of the spine, are now commonly treated by division of the shortened tendons. By running a narrow needle-like knife under the skin to the tendon, and dividing it alone, it is found that there is scarce any danger of inflammation ; while a new fibrous structure becomes developed between the retracted ends, adding to the length of the tendon, and not weakening its cohesive power. To assist this operative procedure bandages and other apparatus are worn for some time, according to circumstances, and the operation may be repeated more than once if the occasion seem to demand. It will be observed, that the operation for the cure of squinting, already mentioned, is conducted on the above principle. We owe the principle to Stromeyer, who first publicly taught it in 1831 ; and its application to the treatment of strabismus to Dieffenbach, of Berlin.

We have now considered, more or less in detail, some of the more important subjects which come under the attention of the surgeon. The limits prescribed to us have made it necessary to select only such as appeared most adapted by their nature or importance to form part of a popular treatise: and we have been the more able to do this from the circumstance, that the article MEDICINE is intended to embrace the general history of disease, and thus to include much matter usually falling within the scope of works on SURGERY. Enough, we trust, has been said to convey a just notion of the progress and present state of this useful and beneficent art, and to show how much may be expected, from its future improvement, in aid of suffering humanity.

INDEX TO THE SURGERY.

VETERINARY ART.

Equine Pathology, under which term we comprehend a knowledge of the diseases to which the horse is liable, as well as of their proper treatment, is based on the same principles as those which regulate the art of healing in the human subject, and a surgeon may be said to possess three-fourths of the necessary knowledge required for the treatment of the diseases of this animal; the remaining one-fourth is, however, so important and essential, that without it his previous knowledge will not only be of little service, but calculated to lead him astray on some of the most important points, and produce dissatisfaction in his own mind, and death, or an increase of the disease, in the animal he may attend. It is essential to know the peculiarities in the structure and functions of various parts, the natural habits of the animal in all their minutiæ, and the peculiar action and effects of different medicaments, which a practical acquaintance with the animal alone can furnish.

History of the Art.

In the classic ages of Greece and Rome, veterinary medicine was regarded with attention, and thought worthy of the utmost consideration. Xenophon, the leader of armies, and Virgil, the prince of poets, did not disdain to write on the subject; and, even at the present day, with all the appliances of modern science, the precepts of these fathers of the art are not to be entirely discarded. With the downfal of the arts and sciences, veterinary surgery sank to the bottom of the pit of darkness, and was perhaps one of the last to approach the light of day. Worse than Egyptian was the darkness in which it was plunged through a long course of years. It was abandoned to the most ignorant of men, and got principally in the hands of those who were employed in shoeing horses, thence called farriers; and thus the treatment of the diseases of the horse was called farriery, which designation, though rather unmeaning, it has retained almost up to the present time. The knowledge of these rude professors consisted, for the most part, of some legendary lore, containing perhaps one truth with a dozen errors, and mixed up with the most absurd and cruel practices. Everything that was too barbarous and too *outré* for human medicine, even when it was at its lowest ebb, was enforced with the utmost rigour on the unresisting victim of man's ignorance and tyranny—the horse; and when kind nature had herself performed a cure in defiance of counteractive treatment, it was at once ascribed to the potent agency of some ridiculous compound. After human medicine had emerged from barbarism, and some most important discoveries had been made in physiological science, the aid which the dissection of animals had afforded in arriving at these discoveries induced some of its professors to turn their attention to the pathology of animals; and the horse, as being the noblest and most valuable of quadrupeds, received the most prominent attention. During the last century, several surgeons pursued as their vocation the treatment of the diseases of the horse, particularly in the metropolis of this country; and various treatises were written by them on the subject. These were considerably in advance of the practices of previous years; but being too closely in accordance with human medicine, various serious mistakes were made, both in the anatomical and physiological arrangement, as well as in the pathological treatment.

Veterinary Art.

Veterinary College.

At length, towards the close of the century, a Veterinary College was established in London, chiefly through the instrumentality of an agricultural society at Odiham in Hampshire; and a Frenchman, of the name of St. Bel, who had studied at the veterinary schools in France, and had greatly assisted in forming the London College, was appointed its first professor. He entered with much zeal into his office, and produced a small work of some merit on the "Proportions of Eclipse." The London College, being supported by a great number of the nobility and wealthy gentry, who became subscribers, which entitled them to the privilege of having their horses treated gratuitously, may thus be said to be fairly established. St. Bel, however, did not long enjoy his new honours; he died about a year after his appointment to the office. With the establishment of the Veterinary College a new impetus was given to the science; a number of well-educated pupils became students; and, after the death of St. Bel, the professorship was held jointly by Mr. Morecroft and Mr. Coleman. The former, however, soon resigned, and for the space of nearly half a century the latter retained the office, making up in a great measure, by his talents and zeal, and medical knowledge, what, for some time, he lacked in practical ability. In this latter qualification, however, he was ably assisted by Mr. Sewell, one of the early pupils of the college, who became associated with him as a coadjutor, and succeeded, on the death of Mr. Coleman, in 1839, to the senior professorship, in which he continues, with the able assistance of Mr. Charles Spooner, Mr. Morton, and Mr. Simonds. Throughout the session, from November to May, lectures are delivered by these gentlemen in the various branches of their profession, the former taking up the anatomy, pathology, &c., of the horse; the second chemistry; and the latter the structure and diseases of cattle and sheep. Amongst the pupils who have studied at the College, some have distinguished themselves as authors, by whom, and others, the art has been greatly improved and advanced; diseases that were formerly thought nearly incurable now readily submit to scientific treatment; and a better system of management, which has been introduced through the medium of veterinary science, effects a considerable saving in the cost of horses in this country, and prevents many diseases whose ravages were formerly considerable. This change is more particularly noticeable in the army, where a veterinary surgeon is attached to each regiment, and holds the rank of a commissioned officer; and the value of his services are highly estimated.

A veterinary school has also been opened at Edin-

Veterinary Art.

burgh, by Mr. Dick, where pupils are instructed in the various branches of the profession.

Royal College of Veterinary Surgeons.

Though the Veterinary College has been under royal patronage for many years, the profession, which now consists of upwards of a thousand members, was not a chartered body till the last year (1843); but it is now duly incorporated as such, under the designation of the *Royal College of Veterinary Surgeons*, and possesses the power of framing by-laws and electing a council and president for the governance of the profession. It is therefore to be presumed, from these salutary measures, that the science of veterinary medicine will continue to advance, and will become, in consequence, of more practical utility to the public.

Composition of animal bodies.

Our object being to concentrate as much information as possible in a very limited compass, and to render this article as unique as possible, we commence with a brief outline of the various parts which compose the body of the horse. It consists of solids and fluids in different proportions, the weight of the latter being six or eight times that of the former. The organization of the frame is due to the solids which surround and contain the fluids. Animal bodies are composed of three forms of tissues, the *fibrous*, the *lamellar*, and the *globular*. The former characterizes the muscular and ligamentous tissues, and, united with the granular, is developed in the texture of the glands and in the medullary portion of the nervous system. Both the fibrous and the lamellar are exhibited in the composition of the cellular substance; and the globular is exemplified in the chyle, the blood, and several other secreted fluids. The combination, in different proportions, of these textures, form the various organs of which the body is composed.

The bones.

The *skeleton* of the horse consists of nearly two hundred bones, which are the most solid parts of the animal frame, to which they give support, and afford fixed objects for the attachment of the muscles and other parts. These bones are of various shapes and sizes, and are connected one to another by strong ligaments or bands, their ends being constructed in various ways so as to admit of motion, some resembling the structure of the hinge, and others that of the ball and socket. Bones owe their solidity to certain earths, the principal of which is the phosphate of lime, the other part of their structure consisting of gelatine and cartilage. When two bones meet together and form a joint, their ends are covered with cartilage, which again is lined by a delicate membrane which secretes the synovial fluid. This fluid prevents friction by lubricating the joint, and is prevented from escaping by the capsular ligament which is attached to the edges of each bone. When this cavity is opened, great pain, irritation, and fever are the consequence. The strength of the joints is still further secured by other ligaments, which run from one bone to another in different directions. The bones of the extremities are mostly long and cylindrical, and of great compactness and strength in the horse. The spinal column is formed by a great number of small bones of very irregular shape, having a hole through their centres for the spinal marrow and joint-like connections with the ribs: they are connected to each other by elastic cartilage, which permits the great flexibility which the spine possesses (though with greater strength) much less in the horse than in man or carnivorous animals. The head of the horse, consisting of about thirty separate bones, is of great size, the principal part of which is devoted to the face, enabling the animal to reach the ground readily, and affording ample space and a secure holding for the particularly large teeth with which the horse is furnished. This space is afforded without increased weight, by the face forming several large cavities.

The teeth.

There are six *molar* teeth on each side of each jaw possessed by the full-grown horse, three of which replace the three temporary ones which the colt alone possessed, and the other three gradually appear as the jaws lengthen and enlarge. There are six *incisor* teeth in each jaw, and two *cuspidati*, or tushes, which, however, are absent in the mare. The incisor teeth replace a similar number of colts', or temporary, teeth, which may be distinguished as being much smaller, shorter, and whiter than the permanent ones. The appearance and changes which these teeth, particularly those of the lower jaw, undergo, enable us to judge pretty accurately the age of the horse for some years.

Mode of judging the age.

A two-year old colt has six temporary incisor teeth in the lower jaw; before he reaches three years, the two central ones are replaced by permanent teeth; between three and four, the two next are similarly replaced, so that a four-year old mouth has two corner temporary teeth alone; these likewise are lost and replaced before the horse is five years old, at which age the mouth is said to be perfect, the tushes having also now appeared. The inner edges of the corner teeth are, however, lower than the outer at five years old. The substance of the teeth is bone, or rather ivory, whilst all the surface that is exposed is covered with a still harder material called enamel, which, after casing the outside, dips down on the crown or face of the tooth, forming a deep cavity, which becomes black from being filled and stained with the food. This cavity, or *mark*, as it is termed, serves as another guide to the age for several years longer; for the teeth, gradually wearing from attrition, take about three years to wear to the bottom of the cavity. Thus the mark in the centre teeth disappears at six years old, in the two next at seven, and in the corners at eight, when the horse is said to be aged. As fast as the teeth wear, or faster, they grow from the roots, and their shape alters, so that by the time the horse becomes fifteen, the oval crown becomes triangular; and, as he approaches twenty, the oval is reversed: the teeth likewise become longer, and spring from the jaws almost horizontally.

The muscles.

The flesh, though apparently a homogeneous mass, is readily separable into a number of distinct bodies of various forms and sizes, which are called *muscles*. These muscles, which are made up of numerous fibres, possess the power of contracting their length, and being attached to two fixed objects, such as bones, draw them together, and thus the motion of the limbs is effected. They are generally attached to these bones through the medium of tendon, a strong white substance, which possesses no power of contraction, but merely serves to communicate the contractile force to the object to be acted on. When the distance is great between the two objects of attachment, it is principally occupied by tendon, by which means strength is preserved, whilst unnecessary size is avoided: thus it is that the legs of horses below the knee are small from the substitution of tendinous instead of muscular substance. Muscles are for the most part voluntary, but some, as the diaphragm and heart, are independent of the will, and therefore involuntary. They are abundantly supplied with vessels,

Veterinary Art.

such as arteries, for their nourishment and support, and veins for the return of the blood after this function has been performed. They are likewise extensively furnished with nerves, which communicate sensation as well as the mandates of the will. These nerves arise either from the brain or its continuation, the spinal chord, so that sensation is first sent from the extremities to the brain by the nerves, and then, quick as the lightning's flash, the will is conveyed from the brain by another class of nerves (though bound up with the others), commanding the muscles to move the limbs.

The brain.

The *Brain* is a soft pulpy substance contained within the cranium, and the spinal marrow, which somewhat resembles it in appearance, extends through a hole in the bones of the spinal column from the head to the tail. The body of the horse is divided into two principal cavities, the chest and the abdomen, which are separated from each other by a muscular partition, called the *diaphragm*.

The chest.

The *Chest* contains the heart and lungs, whose offices are to purify and distribute the blood by means of the respiration and the circulation, whilst the *abdomen* contains the stomach and bowels, in which the functions of digestion, &c., are carried on with the assistance of the liver and the pancreas, besides the kidneys and other supplementary parts.

Digestive organs.

Mastication is performed by the molar teeth, whose faces are broad, so as to grind corn and hay as in a mill. The tongue, which is a muscular organ attached at its roots to a singularly shaped bone called the os hyoides, which connects it with the larynx, serves both to gather the food and submit it to the action of the teeth, and when properly masticated carries the morsel into the pharynx or food-bag, a muscular cavity situated immediately above the larynx. The food having been well ground by the teeth, and lubricated with a proper quantity of saliva, which is secreted by several glands, the principal of which are the *parotid*, situated in the angle just below the root of the ear, is then conveyed from the pharynx into the stomach by means of the *œsophagus*, a long muscular tube, which takes its course down the neck, between the two first ribs, through the chest, and piercing the diaphragm, enters the stomach in the cavity of the abdomen. The food having entered the stomach, is submitted to the chemical action of a peculiar fluid, called the gastric juice, secreted by the lining membrane of this organ. This having been accomplished, the *chyme*, as the food is then called, is passed into the small intestines, and is there mixed with two fluids, one of a watery nature, resembling the saliva, secreted by the pancreas or sweetbread, and the other a yellow bitter fluid, called the *bile*, which is formed by means of the liver, from which it is conveyed to the intestines by means of the hepatic duct.

The *Intestines* are fastened to the spine by means of a strong membrane, called the *mesentery*, which serves as the channel for the communication of the arteries, veins, nerves, and absorbent vessels to and from the intestines. The latter are called the *lacteals*, and open into the inner surface of the bowels, and there absorb the nutritious portion of the food, a milky fluid called the chyle, and convey it to a vessel running along the course of the spine, and emptying itself into a large vein just previous to its joining the heart. It is thus that the blood is continually supplied with nutritious elements to supply the waste which the system is continually undergoing. Although thus furnished with nutriment, the blood is black and impure, and requires to be purified before it is adapted for circulating through the system.

The circulation of the blood.

It therefore enters the right side of the heart, and by the muscular contraction of this organ, is pumped into the lungs, and being divided and subdivided by a multitude of vessels, is exposed to the action of the atmospheric air drawn in by respiration, and by it undergoes a rapid and remarkable change, from a dark to a light colour. Being thereby divested from its impurities, it re-enters the heart by its left cavities and division, and from thence is sent by means of the arteries to all parts of the system, supplying every part with nourishment, and the means of maintaining the temperature of the body. It furnishes also the various glands, not only with their proper nourishment, but also with means for the secretion of their peculiar fluids. Each gland separates its peculiar fluids, and no other, although the same fountain is employed for each, viz., the blood. The *urine* is separated by the *kidneys* from the arterial blood, and is conveyed through long tubes, called the ureters, to the bladder, whence it is excreted from the body. The bile, however, is separated by the liver from the impure venous blood, although this organ is supplied with arterial blood for its own nourishment.

The circulation is carried on by two sets of vessels, the *arteries* and the *veins;* the former conveying the purified blood to all parts of the body, and the latter returning the impure blood to the heart again. The arteries are much stouter than the veins, and possess considerable elasticity; they terminate in minute capillary vessels by which nutrition is carried on and the animal heat developed, and this being accomplished, and the blood rendered black, it enters the capillary veins, which coalescing, the blood is conveyed by the veins to the heart to be again purified. After death there is no blood found in the arteries, but only in the veins, owing to the contractile power of the former, which the latter do not possess; they likewise possess no pulsating power, being too far removed from the heart to be so affected by its action.

The membranes of the body.

There are several important membranous substances, whose offices are very important in the body; first, we have the *cellular membrane*, which is an elastic material, connecting together the various glands and vessels, and existing in the form of cells communicating with each other. It also frequently covers the muscles, and is then condensed and thickened, and possesses much strength. The *adipose* membrane is that which secretes the fat; it is found in various parts of the body, arranged in circumscribed bags, into which the fat is deposited in an oily state. The *mucous membrane* is that which lines all internal cavities and passages having an external opening; it thus continues from the mouth and nostrils, through the intestines to the anus, and also lines the urinary passages, secreting a mucous fluid for their lubrication and protection. Cavities having no external outlet, such as the chest and the abdomen, are lined with a *serous membrane* which secretes a watery vapour, enabling parts to glide on each other without injury. These membranes are of great importance, not only in an anatomical, but also in a pathological point of view, being very frequently the subjects of severe disease.

The various organs and tissues which we have briefly noticed, are connected together in a manner at once the most beautiful and economical. The contents of the

Veterinary Art.

chest and the abdomen are so disposed, that while each organ has sufficient room for the discharge of its peculiar functions, there is yet no vacant space to be found. There is, to use a well-known axiom, "a place for everything, and everything in its place."

Disease.

DISEASE may be defined as a departure from health, or, as Liebig observes, it exists when the vital force is weaker than the chemical forces opposed to it, whilst death occurs when all resistance to these forces ceases. It may be either structural or functional, that is, it may be owing to an alteration of the structure of an organ or part, or merely a derangement of its functions: inflammation of a part, such as the foot or eye, is an instance of the former, whilst simple fever is an example of the latter. We may have both these states combined: for instance, a part may be in a state of inflammation; its structure may be thereby either temporarily or permanently altered, and at the same time fever being excited in the system, the heart may send the blood with double rapidity through the body, and be thus diseased in its functions, whilst its structure may continue unchanged.

Fever.

Simple fever is an example of diseased function, though it often produces local inflammation. It is, however, very rare in the horse, as an independent disease, there being generally some local affection when fever is present in the system, and when it does occur, local inflammation more rapidly supervenes than in the human subject. Though less subject to fever, however, the horse may be considered as more liable to—

Inflammation.

Inflammation.—The symptoms which usually attend an inflamed part, though all of them are not present, in every case, are swelling, redness, pain, and heat. The swelling is in the first instance owing to the distended state of the vessels of the part; but afterwards effusion from the surfaces of these vessels takes place: the redness is to be attributed to the greater quantity of blood contained in the vessels, and often to the presence of the red particles of the blood in minute vessels, which in a state of health are too small for their admission. The pain is produced by the pressure of the enlarged vessels on the nerves of sensation: this symptom, however, is not so invariably present as the others, and depends partly on the amount of the swelling, and partly on the sensitiveness of the affected organ. Heat is an invariable symptom, and is owing to the development of a more than ordinary quantity of caloric (the principle of heat), from the presence of an unusual portion of arterial blood. An inflamed part, therefore, is more abundantly supplied with blood than when in a state of health; and if the inflammation continue, the blood-vessels become enlarged, and sometimes new ones are formed; permanent enlargement of a part takes place. We have frequent instances of this in the horse, as, for instance, in the thickened state of the flexor tendons of the legs, which often remains after inflammation has subsided.

Inflammation is subject to much variety, depending on the nature, and situation, and importance of the organ, and the degree of severity in which it may exist. It may attack an unimportant part, and produce no constitutional derangement, or it may affect the brain, the bowels, or the lungs, and excite in the system symptomatic fever to a most formidable extent. In the former instance, the inflammation is usually called local, its effects being confined to a particular part; though strictly speaking, inflammation is always local, the symptomatic fever which often attends, being owing to the irritation diffused through the system by means of the nerves, and acting on the heart so as to cause its increased action. Thus local inflammation often produces fever in the system, and on the other hand, general fever sometimes produces local inflammation.

Inflammation may be either acute, sub-acute, or chronic. The former is inflammation in its most active state, an *actual* flame, and is frequently, though not always, attended with symptomatic fever: the second is inflammation of a mild or subdued character, a sort of smouldering fire, and is less frequently attended with constitutional irritation: the third denotes a long-continued and settled inflammation, the smouldering embers of the conflagration which the first kind had established.

Inflammation, although a disease, is yet but the result of the too active existence of a process which is most essential to the system, and without which wounds would not heal, or the loss of parts be restored. It may be excited by various causes: bruises, strains, and injuries may produce it externally; and internally it may be occasioned *directly* by the actual contact of an irritating object, such as a drastic purgative or poisonous substance; or by the too great action of a particular part, as the lungs in over-exertion, or otherwise indirectly, as when catarrh is produced by the application of cold to the skin. Inflammation is much governed and directed by the idiosyncrasy, or peculiar susceptibility of the animal. It is rare that every organ is formed equally strong: in some the lungs is the weakest, and in others the liver may be the most vulnerable; and thus the same cause will produce different attacks in different animals. This, too, is much influenced by the season of the year, and the age of the animal: diseases of the abdominal organs are more frequent in the summer, and those of the air-passages in the winter; and young horses are more susceptible to the latter, and old animals to the former.

Plethora.

Plethora, or a redundancy of blood in the system, is not unfrequently the cause of inflammation, though not so frequently as in cattle and sheep, from the circumstance of the horse being in some measure relieved by active exercise. When every vessel of the body is loaded with blood of the richest and most stimulating character, we cannot be surprised that inflammation of the most susceptible organ, or that most exposed to disease, should arise. In human pathology inflammation is spoken of as being either *phlegmonous* or *erysipelatous;* in the horse it is nearly always of the former character, and very seldom of the latter. The eruptive affection of the skin called *erythema*, being almost a singular instance.

Effects of inflammation.

The results of inflammation under disease are simply those carried to excess which occur in a state of health, and are necessary and natural processes for the repair of the effects of an injury. When the inflammation gradually subsides, without any of the other effects, a result which in disease we are always desirous of accomplishing, it is termed *resolution.* When the fibrine or adhesive portion of the blood is deposited, it is termed *adhesion;* this is often the result of inflammation of a *serous* membrane, such as in pleurisy, and it is likewise exemplified in the healing of a wound by the first intention. *Suppuration* is the termination of inflammation, to which mucous membranes are most

Veterinary Art.

disposed, and it is best illustrated by the formation of pus or matter in an abscess. Adipose tissue is more disposed to suppuration, and the cellular membrane to adhesion. *Ulceration* is the absorption or removal of substance, a sequel of inflammation, also illustrated by an abscess, and which always takes place before it bursts, the substance between the matter and the skin being gradually removed at some particular part, where the abscess is said to point. It may occur, however, either with or without suppuration, and it may be either in a healthy or an unhealthy state. In the former, the ulcer, as a running sore is called, soon heals, and in the latter, it will gradually spread and increase. It sometimes attacks the cavity of a joint, and then it is very rarely attended with suppuration, but usually with adhesion.

Mortification or gangrene, as the death of a part is called, is a less frequent termination of inflammation in the horse than in the human being. Bone and cartilage, and parts whose circulation are inactive, are most liable to this process. A bone when much injured often becomes carious, a portion becomes dead, and exfoliates, as casting-off is termed.

Before we can speak of the pulse as the best indicator of inflammatory action, or of those remedics which we find most available, it will be essential to notice the peculiar properties of the blood, and the phenomena which obtain with regard to it.

The blood. The *Blood* is not only the most abundant, but also the most important fluid in the animal economy. It furnishes every part of the body with nutriment for its growth, and affords the material from which the various fluids are secreted, and influences considerably the strength and disposition of the animal. Formerly its derangement was considered as the sole cause of disease, whence the term humoral pathology; but this theory has in great measure given place to another, in which the solids are considered the principal agents, and seats, of disease. We find, however, that there is some truth in both these doctrines: the solids are subject to morbid affections; and that the blood is occasionally both altered in its composition and impaired in its quality has been satisfactorily proved by late research, and is, for example, the primary cause of the symptoms of fever.

Composition of the blood. Three-fourths of the blood is composed of water, which is essential in order to preserve it in a liquid state, and enable it to flow freely through the intricate labyrinths and minute and circuitous channels which nature ordains it to take. The other elements have each their distinct office to perform, and the whole is essential to preserve it whilst in the vessels of the body in an apparently homogeneous state. When, however, it is removed from the body, it soon separates into different portions. After some hours we observe a division between the solid and fluid parts; the former floats in the latter, and is called the *crassamentum*, whilst the liquid is termed the *serum*. The serum is composed principally of albumen and water, which can be separated by the application of heat, and the crassamentum chiefly consists of fibrine and the colouring substance or red globules, with which are mixed various salts. These parts may be separated by washing; and they also appear when the blood is long in coagulating; the red portion, being the heaviest, falls to the bottom, whilst the fibrine remains at the top, constituting what is usually termed the buffy coat of inflammation. These particles of the blood do not nourish, but convey oxygen, for the purpose of heat. The blood, it is well known, is considerably darker in the veins than in the arteries, being in the latter of a bright scarlet, and in the former of a dark purple hue. The red tinge of arterial blood is considered to be owing to the presence of various salts, and the dark colour of venous blood to that of carbon, which is prevented from rendering it quite black by the salts. The blood becomes, by means of respiration in the lungs, in great measure freed from "carbonaceous principles," which being removed, it acquires, through the salts, its scarlet colour. The air, by being respired, loses a great portion of its oxygen, and acquires carbonic acid gas in its place. This gas is produced by the chemical combination of the carbon of the blood with the oxygen of the atmosphere; but the greater portion of the lost oxygen is absorbed by the blood, enters into the circulation, and conveying with it a considerable quantity of caloric in a latent form, is the medium by which the body is supplied with animal heat: this caloric becoming sensible in the capillary vessels, obedient to a law of chemistry, that when carbon is formed heat is elicited. Thus in cold countries a greater quantity of animal heat is required than in hot climates; to supply which more oxygen is inhaled, more nutritious food consumed, and more carbon extricated. It should be observed, that the lungs are greatly assisted in the removal of carbon from the blood by means of the liver, which for this purpose is largely furnished with venous blood. Thus when one of these organs is diseased and unable to perform its functions, the other likewise becomes deranged, having a double duty to perform. The blood, although composed of various substances, which readily separate when removed from the body, yet appears as a simple fluid whilst circulating in it. It has been discovered by the aid of the microscope to contain an immense number of small globular bodies, computed to be about 3·500th part of an inch in diameter. The globules of the blood are suspended in the serum by means of the vital influence derived by the blood from the vessels and organs through which it passes; which also is supposed to give them a rotatory motion and a mutual repulsion towards each other, whereby they are kept asunder. As the blood, however, enters the capillary arteries, its globules are attracted and appropriated as required for the purpose of nutrition. The blood is thus preserved by its vitality from coagulating or disuniting whilst circulating; but when removed from the body, and thus deprived of vitality, it both coagulates and separates; and thus coagulation is longer or shorter in taking place in proportion to the vitality possessed. Thus, when the animal is weak and low, it quickly congeals; and when full of vigour and excitement, it often takes a quarter of an hour to do so, and gives full time for the fibrine and the red particles (which have no longer any vital influence to keep them together) to disunite and follow the influence of gravity.

Veterinary Art.

Changes of the blood effected by respiration.

We have alluded to the vital influence which the blood derives from its vessels. These vessels or arteries are abundantly furnished with a peculiar class of nerves, developed by modern science, which have nothing to do with conveying sensation or the motive will, but are devoted to the superintendence of organic life. They arise neither from the brain nor spinal chord, but from various knots or ganglions, which receive numerous

branches from other nerves, thus keeping up an intimate communication between all parts of the nervous system. The heart is controlled by nervous influence in a still greater degree; it holds direct and powerful communication with the brain, and it is influenced with the speed of lightning by most of its sensations, and is instantaneously affected by mental emotion. If we approach a nervous horse we well know how greatly the pulse is increased, and it is sometimes several minutes before it is reduced to its natural standard.

The pulse.

The *Pulse* is felt in any part of the body in which an artery approaches sufficiently near the surface to be felt. It appears like a jerking action of the artery; but if we lay bare the vessel, as in the nerve operation, we cannot perceive any of the action, although it may be felt by slightly compressing the vessel. It is therefore principally owing to the powerful muscular contraction of the heart, which thus sends the blood with greater force and by successive jerks into and through the arteries; so that if we slightly compress the latter, the impetus is felt constituting the pulse. The circulation of the blood is, however, supposed to be assisted by the elastic and muscular coats of the arteries. The pulse, our principal and best indicator of disease, may be felt either at the heart or the arteries; the beating of the former, however, slightly precedes the latter, though not perceptible to common observation. In health the degree of strength, as well as quickness, corresponds both in the one and the other; but sometimes in disease the artery can scarcely be felt, whilst the heart at the same time beats hard and with apparent force against the side. It is, therefore, often necessary to examine the pulse both at the side and at the jaw. The different varieties of force, &c., &c., with which the heart beats has been characterized by various terms, such as hard, soft, full, small, intermittent, irregular, quick, slow, &c.; but sometimes these distinctions have been in equine pathology carried further than practical examination will warrant or justify.

Variations in the pulse.

The *average pulse* of a horse may be considered to be about 35 in a minute; in some we find it as low as 26, in others as high as 42: under disease it as often greatly increased, sometimes indeed much exceeding a hundred. An increased state of the pulse is in itself an evidence of much derangement of the system, unless it be merely owing to exertion or temporary excitement. It shows that the blood is hurrying through its vessels much quicker than it ought. A *quick pulse* may be produced by exertion and mental excitement, as before observed; or it may be owing to pain, local inflammation of a part, or disordered state of the blood as in fever. Though pain is not an unfrequent cause, yet it does not invariably produce a quick pulse; but when it does so it is by irritating the nervous system, and then the pulse is not only quick but strong, as in the case of an open joint, and the blood seems to possess an increased vitality. Local inflammation is one of the most frequent causes of quick pulse in the horse, and its agency in producing it depends very much on the importance and magnitude of the organ so inflamed. The eye or the foot may, for instance, be affected without producing an increased pulse; but the lungs, the brain, or the kidneys, are never acutely inflamed without exciting greatly the action of the heart. Inflammation is an increased action of the capillaries of a part—more blood is contained by such part; but this is not all, for more blood may be possessed when the part is *congested*, the distinction being that the former is an active and the latter a passive state of the vessels. It is thus essential either that a local inflammation should occasion pain, or that it should cause an interruption to the flow of blood or other fluid, or at any rate that it should be of a certain magnitude and importance, in order to produce a quick pulse. A *quick hard pulse* is often termed an inflammatory pulse, but such term is by no means appropriate, for we may have this so-called inflammatory pulse without inflammation, and inflammation without an inflammatory pulse. Such pulse does not in many instances so much depend on the local inflammation present as on the condition and the idiosyncrasy of the animal. Another variety of quick pulse is that found in fever and influenza: it is usually soft, and when greatly accelerated, small and weak; there is an increased quickness of the heart's action, but a decreased power; and though the system is disturbed, there is often no local inflammation present of any consequence. Such pulse is usually attended with an incapability of bearing much depletion, and a rather dark state of the blood, which soon coagulates and never has a buffy coat.

We rarely find an unnaturally *slow pulse* in the horse, but when present it often denotes some affection of the liver, or it may be owing to sluggishness or debility of the system, though debility is oftener attended with a quick weak pulse. A *full strong pulse* generally denotes an abundance of the circulating fluid, and a capability of bearing blood-letting, if required. If quick as well as strong, it betokens excitement of the system, and perhaps local inflammation. We usually find such pulse in acute rheumatism or chill, as it is commonly termed, and sometimes in chronic rheumatism. It also accompanies most diseases attended with much pain, and is found in cases of open joint: it denotes great irritation of the organic nerves. A *soft pulse*, if not quickened, betokens a state of health, though sometimes a too great languor of the system. A *hard pulse* generally attends inflammation; it may accompany a full pulse or not. A wiry pulse is one of its varieties, being small and hard, feeling indeed much like a wire. A *small weak pulse* denotes a low state of the vital functions, and is generally attended with dark blood, and forbids blood-letting to much extent. It accompanies the absence of nervous energy, and the want of excitement, and is often present when the body is cold. In the early stages of inflammation it bespeaks an incapability of bearing much depletion; and in the latter stage, an exhaustion of the nervous energy and the vital powers. When it attends inflammation, it is always very quick.

An *intermittent* pulse is sometimes met with in an apparently healthy horse, though it is somewhat doubtful whether there may not be some latent disease present. When it follows a quick pulse in inflammation, and particularly after the exhibition of digitalis, it is a favourable type, and appears to be a method of nature for lowering the heart s action. An intermittent pulse may be either regular or irregular; the former is much more favourable than the latter. Indeed, an irregular vacillating pulse, whether intermittent or not, is a very unsatisfactory sign, and often appears as the precursor of death. The nature of the pulse requires these observations, for it is one of the best and surest guides in the treatment of disease, and particularly in the practice of blood-letting.

Veterinary Art.

Blood-letting.

Amongst the remedies for inflammation, the most prominent, and in the horse decidedly the most important, is *blood-letting;* and it is most essential to know when to practise it, and when to abstain. The history of blood-letting in the human subject is almost coeval with the practice of physic, and in animals its antiquity is almost as great. In the former its effects were found so considerable when first introduced, that it became very generally adopted, and indeed far more extensively than at present, for the now widely extended *materia medica* furnishes the scientific practitioner with numerous medicaments that enable him to dispense with bleeding in many diseases in which it was formerly practised. Till very recently it has been the practice to carry bleeding to a great extent in the horse, to adopt it on each and every occasion; and even at the present time it is the custom of farriers to resort to it in every case, no matter what the symptoms may be, satisfying their consciences by the ignorant *placatio*—that if it does not do good, it can do no harm.

Mode of performing the operation.

Bleeding is performed either with a lancet or a phleme; the former is the more difficult, and requires a skilful hand, and a sharp point to the instrument. The right side of the neck is the most convenient situation. The head being elevated so as to put the vein on the stretch, the latter should be pressed with the fingers of the left hand, and the skin and vein opened with the same incision, about six or eight inches below the angle of the jaw. In using the phleme, the left side is the most convenient; the instrument being held in the left hand which presses the vein at the same time, it should be struck smartly on the back either with the side of the right hand, or an instrument called a blood-stick. In bleeding from the arm or the thigh, the phleme is the most suitable instrument.*

Effects of bleeding.

In a case of simple plethora, the first gush of blood appears of a dark colour, which is owing to its detention in the vein, by pressing with the finger in order to make it swell or rise. As the operation proceeds, the blood becomes lighter, and this is in proportion to the rapidity of the current, which, if very great, as it often is, if the horse will eat hay or grass at the time, the blood is of a red or arterial hue. After several quarts have been removed, the blood generally becomes darker, and does not flow so rapidly, and the pulse, at first strong and full, becomes softer, less full, and sometimes quicker; and if the bleeding is carried to a considerable extent, almost or quite imperceptible, the horse hangs his head, shifts his weight from one foot to another, and exhibits other symptoms approaching to *syncope*, though it is very rare that actual fainting is produced. During the operation, the membrane of the nostril and the eyelids gradually change from a red to a pale colour; and the mouth, at first hot, becomes by degrees cool. Some little time after the bleeding, the pulse is increased in quickness, though still comparatively weak, which may be in great measure attributed to re-action. The immediate effect of bleeding then is to diminish the supply of blood to the right side of the heart: that organ has less to send to the lungs—a smaller quantity is reddened and purified—less oxygen is absorbed from the atmosphere, and a diminished quantity of purified blood is conveyed to the left side of the heart, and thence through the system. The supply of arterial blood being diminished, the small vessels become less distended, and thus the various membranes are rendered pale, and there being less blood supplied, there is less caloric given off, and thus the mouth and other parts become cooler. The stomach quickly sympathizes with the general depression, and a sense of nausea and loss of appetite is induced. The brain and nervous system are very early affected by the loss of blood, occasioning a want of energy, weakness and depression of spirits, and it is probably in great measure through the nervous system that the sedative effect on the heart is produced. The quantity of blood in the vessels, though temporarily reduced, is very soon restored by means of absorption of watery fluid, that would otherwise have passed off by other channels, but the blood is rendered considerably weaker; the fibrine and the red globules that have been removed are by no means restored—this can only be done by means of the chyle, and in the course of time. When the loss of blood by bleeding is rapid and considerable, the pulse can scarcely be felt; and if depletion is carried further, the brain is deprived of its supply, and thus fainting is produced, which may take place earlier or later, according to the rapidity of the current, and the ability of the animal for losing blood: it is therefore very important that the blood should flow as rapidly as possible and from a large orifice.

If the blood has previously been too stimulating, abounding too much with fibrine and albumen, and thereby exciting too much the heart and blood-vessels, we obtain relief by rendering the blood poorer by venesection; but if the blood was previously poor, we produce by bleeding a state of debility difficult to overcome. Another effect produced by bleeding, and perhaps more important than any yet considered, is the powerful sedative influence it has upon the heart and arteries. This it is that we seek to obtain in cases of inflammation: when an important viscus is actively inflamed, and the heart is pumping the blood with double rapidity and force through the frame, and keeping up general irritation and local inflammation, by abstracting a large quantity of blood, we depress the action of the heart, and cause a less quantity of blood to be sent to the inflamed part, in common with other parts of the body: we do so not only by diminishing the quantity of blood, but still more by lessening the force with which this quantity is sent, thereby giving the part time to relieve itself from its superabundance of blood. Thus by the loss of blood three important effects are produced in the animal economy—a diminution in the quantity of the blood, an alteration in its quality, and a sedative effect on the heart and arteries.

Cases in which blood-letting is required.

A plethoric state of the system requires bleeding, and particularly in the spring of the year: when the horse has been highly fed, and little worked, full of flesh, and heavy, and sluggish in consequence, the abstraction of a few quarts of blood will be useful, and perhaps prevent inflammation of some part. It should not, however, be carried to a great extent. If a

* After bleeding, a swelling sometimes takes place round the part, from the escape of blood under the skin. This *thrombus* generally disappears, either without treatment or by means of cold applications. Inflammation of the vein, however, sometimes follows; the swelling, if in the neck, extends upwards, feels hard; the passage of the vein is obliterated, suppuration occasionally appears with sinuses, and sometimes hæmorrhage. The head should be tied up for a week; soft food only should be given, fomentations and cold lotions employed topically, and succeeded by repeated blisters. If there is bleeding, a styptic or caustic may be applied to the wound, but by no means injected into it.

Veterinary Art.

greater reduction is required by the system than this will produce, a dose of physic should be given which will lessen the quantity of blood, by the removal of some of its serum, and it will in some measure diminish the supply of chyle. The plan of periodical bleeding is to be deprecated, for the desired effect can be obtained by abstinence and physic.

Inflammatory diseases in the horse are more frequent than in the human subject, and blood-letting is demanded in the greater number of them. It is not, however, sufficient merely to ascertain that inflammation exists in order to practise bleeding, particularly to a large extent; for inflammation may exist, and yet the pulse be so feeble that bleeding will be injurious, and perhaps fatal, and be the means of throwing away what chances we possess of saving the animal. It is still less sufficient to determine on bleeding merely because the pulse is quick; for this state may exist without any inflammation, and without requiring or benefiting by the operation. If in an inflammatory case we have reason to expect a superabundance of fibrine in the blood, then bleeding will be demanded, and to a free extent. We may anticipate this state of the blood when we find a strong, full, and quick pulse; and we shall then perceive the blood a long time coagulating, and presenting afterwards a thick buffy coat: we may ascertain this even while the blood is flowing, by touching its upper surface in the vessel with the finger, on which it will leave no stain. The proportionate quantity of buff is much greater at first, and gradually diminishes, which may be ascertained by receiving a little in different glasses at the commencement, the middle, and the end of the operation. It is also much greater if the orifice is large, and if it is caught in a narrow vessel, the influence of gravity causing the heavier red particles more readily and abundantly to separate. The extent of the bleeding must be regulated not only by the appearance of the blood, the readiness of its flow, and the strength of the pulse, but also by the severity of the inflammation and the importance of the organ affected. If, for instance, the above symptoms exist in a case of acute inflammation of the lungs, we can scarcely take too much or take it too rapidly. We should, if possible, knock down the disease by the first blow; and we shall generally succeed in so doing, for the appearance in such severe cases of buffy blood not only shows the propriety of blood-letting, but also the capability for bearing it. The pulse in this, as in almost every instance, should guide us as to the quantity to take: the bleeding should be continued until it becomes almost, if not quite, imperceptible. In all cases of rheumatic inflammation—and these cases are by no means so rare as is generally supposed—and in almost all instances of inflammation of a fibrous part, such as the cavity of a joint, the fibres of a muscle, and also in most cases where acute pain is present, we shall find a full, strong, and quick pulse. Indeed, this is the true pulse of irritation, and not a quick weak pulse, as used to be supposed.

Let us take, for example, a horse with a bad open joint, there is great irritation of the whole system, and the pulse is strong, full, and accelerated. The horse is bled, and we find a buffy coat on the blood: the joint is not closed—the irritation continues; the pulse soon acquires its former character; the animal is again bled, and the buffy coat is again exhibited. This may be repeated again and again; the poor animal loses flesh, is almost a skeleton, can scarcely stand, and at length dies; but almost to the last he exhibits a strong pulse and buffy blood. We well know that nothing produces so rapid a loss of flesh as acute pain. In such case the whole nervous system is in a state of irritation; the organic nerves which supply the blood-vessels equally participate, and the blood-vessels are irritated, if not inflamed. The fibrine of the blood, instead of being attracted by the coats of the capillaries, and thus contributing to the growth of the body, is hurried forwards into the veins, and thus the venous blood becomes loaded with fibrine, whilst the solids are almost exhausted from its absence, and of course the animal is considerably and rapidly impoverished. Although a single bleeding or two may be useful in such case, yet it is clearly evident that its frequent repetition will fail both in altering materially the character of the pulse, as well as the appearance of the blood. Both the blood and the pulse can often be restored to a state of health by other means, either by medicine, or, as in the case of an open joint by closing the cavity, and removing the cause of irritation.

Sometimes a strong full pulse, and its usual concomitant buffy blood is principally owing to the idiosyncrasy of the animal, which may possess such pulse, but which may be increased by the irritation of disease, contrary perhaps to the usual character of such disease. Thus when influenza has been prevalent, perhaps in one case out of twenty, instead of the usual soft pulse there has been a hard strong pulse and buffy blood, contrary to the usual indications of the disease; therefore, though as a general rule inflammatory cases require blood-letting, there are exceptions that should always be borne in mind.

Cases forbidding blood-letting.

Let us suppose that a horse is overrun in the chase—is exhausted and can scarcely stand—his flanks heave laboriously, and if a vein is opened, the blood is black and flows with difficulty, and the lungs are congested with black blood: should we bleed in such a case? When an animal is exhausted with exertion, the blood becomes much darker than usual, and the flesh decomposes more rapidly than otherwise. When the circulation is thus hurried by exertion, the demand for arterial blood in every part is so great that the lungs cannot purify it with sufficient rapidity, and consequently it is imperfectly done; and this imperfection increases until, loaded with carbon, it is no longer fit for the purposes of life: impure blood is sent to the brain, and the animal dies. It would at first sight seem that the removal of some portion of this dark impure diseased blood must be desirable and calculated to relieve the loaded lungs; but let us look a little further: the powers of life are greatly reduced, the system is exhausted, and the vitality of the blood and its vessels are considerably impaired; by removing, then, any portion of blood, impure as it is, we substract from the system the vitality which it possessed, and reduce still further the nervous energy, and thus hasten a speedier dissolution. The exhausted system requires assistance; the waning powers of vitality need support; the nervous system demands a stimulant. An ounce of laudanum and two of spirits of nitrous ether, with a pint or less of water, or a pint or more of brandy and water of the usual strength, or a bottle of port wine, will often restore the vital powers, and enable the system to contend effectually against the approach of death; and as the pulse becomes perceptible, and the dark colour of the blood changed, blood-letting may be

Treatment of over-exertion.

Veterinary Art.

practised if required, with safety and success. In all cases in which the pulse is low and feeble, the treatment should commence with a diffusible stimulant; and bleeding should not be practised until the stimulant has strengthened the pulse and re-action has commenced. If we bleed in the latter stages of inflammation, within perhaps 12 or 24 hours of death, we assuredly hasten the period of dissolution, and perhaps produce almost sudden death, although we only remove a few quarts of this dark impure blood, which appears so unfit for the purposes of life. The repetition of bleeding is often resorted to empirically, and without principle. It is not uncommon in severe inflammation, if the horse appears no better in the course of 6 or 12 hours, to bleed, and again a third or a fourth time for the same reason, regardless alike of the actual state of the case or the ability of the horse for bearing depletion. By such practice a fatal termination is not only greatly precipitated, but what chance there may be of recovery is altogether thrown away. The propriety of repeating the bleeding should be regulated by the principles we have endeavoured to establish: it should be practised with caution and with the finger on the pulse.

Local bleeding.

Local bleeding is a practice to which we are very favourably inclined. We can seldom abstract blood from the inflamed part itself, but as near to it as possible, taking care that if we open a vein, it shall be between the heart and the seat of inflammation. We can rarely resort to local bleeding in the horse for severe internal inflammations, the thickness of the skin and the presence of the hair precluding the application of both leeches and the cupping-glass; and we are compelled to limit our practice almost entirely to the opening a vein or an artery. From the size of our patients, and their consequently large veins, we can open them in various situations with convenience and good effect. For severe *strains* of the flexor tendons we may open the brachial or the saphena veins with much advantage, and remove a large quantity of blood. For *Laminitis* we may bleed from the foot, opening the circular artery and abstracting blood in a large and copious stream. For various diseases of the foot, or near it, we may also bleed from the toe or the coronet, placing the foot afterwards in a pail of warm water to encourage the bleeding. For inflammation of the gums we can bleed from the mouth: for ophthalmia or injuries of the eye we can abstract blood locally, by scarifying the lids, lancing the bars of the mouth, and opening the angular facial vein, or the jugular. Each spot has its peculiar advantage, and deserves a preference in particular circumstances. One important rule should be observed in local bleeding in severe cases, such as acute strains; that is, to abstract blood enough locally to affect the system generally; by so doing we gain the advantage of both local and general bleeding. If we do not carry it to this extent, and the pulse is strong, the little blood we abstract locally will soon be supplied by the system almost as plentifully as before; therefore, if we cannot obtain in such case sufficient blood, it will be desirable to bleed generally at the same time.

Re-action.

There is another point that deserves particular attention, and that is, the tendency of bleeding to produce a re-action. We bleed for internal inflammation, and appear by so doing to subdue it altogether, but in the course of 12 or 24 hours perhaps it rages as strong as ever. The disease, it is said, is returned; but no! it is re-action, as Dr. Copland well shows, and produced sometimes by the excess of bleeding. How desirable then is it to guard against this re-action; and for this reason, after bleeding, we employ sedatives, our belladonna, our digitalis, or white hellebore, and by their means prevent the fire in a great measure from again flaming forth; and this, we take it, is the chief use of these medicaments.

When the blood abounds with fibrine, as in many inflammatory and rheumatic diseases, we may assist the bleeding and prevent perhaps the necessity of a second operation, by administering medicines calculated to attenuate the blood, such as tartarized antimony, calomel, cream of tartar, digitalis, the carbonates and salts, with plenty of diluents. When the blood is very dark, there appears to be a deficiency of its saline constituents, and we shall then probably find much advantage in employing the chlorides, and fixed alkaline salts.

When the clot is very loose and coagulates rapidly, indicating considerable debility of the system, tonics, vegetable and mineral, camphor, and the alkalis, are called for. When the blood is very deficient of fibrine, acids are found the best restorative of this constituent, and prevent attenuation of the blood. In dysentery and profuse diarrhœa, where the watery portion of the blood is considerably diminished, diluent liquids should be given, with astringents, mild tonics, and saline matters.

It should not be forgotten that blood-letting greatly promotes absorption. In cases, therefore, of inoculation with morbid matter, the bites of venomous reptiles, a local disease that may become constitutional, abscess, and unhealthy ulcers—in such cases bleeding should be carefully avoided.

Purging.

Purging, as an agent in the treatment of inflammation, is not so available in the horse as in the human subject, in consequence of the greater danger that attends the operation, and more particularly in inflammatory affections of the air passages. In these cases the utmost caution is required, for numbers of horses have been destroyed by the injudicious administration of physic. For local inflammations of the limbs and other parts, purgatives are still in requisition, and are also generally employed in getting a horse into condition. The *modus operandi* of a purge is by stimulating the internal coat of the bowels, and causing a greater flow of blood to it, and consequently a greater secretion of the watery fluids; it excites also the muscular coat, and causes a greater peristaltic action of the intestines, by which means their contents are rapidly hurried onwards and discharged. Its immediate effects on the system are—firstly, the depression it causes in the nervous system, and thereby on the action of the heart and arteries, giving time for an inflamed part to recover its natural tone during the existence of this depression; and secondly, the removal of a portion of the circulating fluid from the body. It is by this latter effect that a horse is got into condition; he comes up perhaps from grass loaded with flesh and fat, but is unable to perform active work, and sweats readily from the slightest exertions. Nothing assists so much in altering this state of things as a dose of physic; the superfluous serum and fat is removed from the system, and exercise being added, the horse becomes lighter and stronger, in better wind, and fitter for the performance of exertion. The best purge that can be given to a horse is Barbadoes aloes; an ordinary dose is from five to six drachms melted in a water bath, and mixed with one drachm of ginger and two drachms of

A purgative ball.

Veterinary Art.

treacle. Although this may be considered as a medium dose for a full-sized horse, yet some are purged with three drachms, and others require upwards of an ounce, depending on the strength of constitution and the susceptibility of the intestines. Light heron-gutted horses are much easier purged than animals with a good carcase. Before administering a dose of physic, it is desirable to know exactly the quantity the animal requires to act properly on him; and if this knowledge cannot be obtained, it is better to give under than over the amount he may appear to require. From the length and extent of surface of the intestines, a dose of physic, if given in a solid form, as it usually is, takes about twenty-four hours before it begins to purge; it is therefore better to give it in the morning, the animal having had for one or two days previously bran mashes, no corn and but little hay. When a horse is well mashed, a less dose of physic is required; it will also act better, and with less danger or inconvenience. After the physic has been administered, the mashes should be given warm, and lukewarm water to drink *ad libitum*. The following morning the horse should have walking exercise; but if the motions are soft and frequent, he should be put in the stable again; and if the physic does not act, the animal may be trotted. So that in fact we can control the operation of the physic by the amount of exercise; care, however, being taken that it is not too severe, and that the animal does not take cold, as from the weakness and depression of the nervous system there is a chilliness and a greater susceptibility to the influence of cold air. The warm bran mashes should be continued during the action of the physic. A little corn may be given in the evening; and on the second day after the administration of the ball the horse should remain quietly in the stable, having, however, his usual food; and he should not be worked till the next day, and then very moderately. When it is desirable to administer another dose, an interval of a week should elapse between the first and second ball.

Treatment of the horse in physic.

Laxatives.

When merely a relaxed state of the bowels is required, and this in many diseases is the safer course, a half dose of physic or laxative may be given, so as to produce a pultaceous state of the fæces without active purging.

Diuretics.

Diuresis is the increased action of the kidneys, from more blood being determined to these glands, causing more urine to be secreted by them. It thus acts in somewhat the same manner as a purgative, by diverting blood from an inflamed part and getting rid of superfluous water in the system; but it can be employed with greater safety, and is, therefore, more available in internal inflammations; and is particularly useful in dropsical swellings of the legs. The following is a useful formula :—

Powdered yellow resin	4 drs.
Nitrate of potash	2 ,,
Powdered ginger	1 dr.

To be beat up with sufficient soft soap to form a ball. A diuretic acts much more quickly than a purge; it should therefore be given early in the evening, and its effects will have passed off in a great measure by the morning. The horse will not imperatively require any alteration in the diet or cessation from his usual work.

Sedatives.

Sedative medicines are often administered in inflammations; their effect is to lower the action of the heart and arteries, and this is accomplished in various ways; some, such as the *white hellebore*, in doses of a scruple, or small quantities of aloes, produce nausea in the stomach, and this depresses the nervous system in the same manner as emetics act in the human subject. From the peculiar conformation of the stomach, and curvature of the œsophagus as it reaches it, the horse is unable to vomit, though he may feel sickness or nausea. *Digitalis* or *foxglove*, in doses of half a drachm to a drachm, appears to act specifically on the heart, lowering its action, and producing, temporarily, an intermittent pulse. Belladonna, or the deadly nightshade, seems to act directly on the nervous system, the action of which it lowers. About two drachms of the extract of belladonna is an ordinary dose. Opium is also a valuable sedative, in doses of a drachm, and, combined with the protochloride of mercury, in a similar dose, its assistance is often very valuable.

Sudorifics.

Sudorifics, as a remedy for inflammation, are much less available than in the human subject. We cannot, as in man, throw a horse into a profuse perspiration; and a warm-water or vapour bath, from the size of the animal and his hairy covering, is a very inconvenient remedy. When, however, the skin feels chilly, and we wish to determine blood to the surface, we may produce this effect by giving a drachm of camphor and one or two ounces of spirit of nitrous ether, suspended in gruel, or with water thickened with linseed meal so as to suspend the camphor, which will not dissolve in water.

Fomentations.

In the treatment of local inflammation, in addition to the foregoing remedies, which act on the system at large, as well as local bleeding, which has also been noticed, we have several other resources. *Warm fomentations* act by relieving the inflamed vessels by means of perspiration or the escape of fluid externally through the pores of the skin. In applying them, a thick flannel should be used, not too wet, but kept closely to the part for some time. *Warm poultices* act in the same manner, but, of course, produce a more constant effect.

Lotions.

Cold applications relieve inflammation by means of *evaporation;* heat is thereby abstracted from the inflamed part, and the action of its vessels is lowered with its temperature.

Counter-irritation.

Counter-irritation is another method of removing inflammation; it is most available after other treatment, and when the disease becomes sub-acute. It acts by exciting artificial inflammation in another part, and thereby diverting the blood from the old mischief. Blisters, setons, and rowels are the principal remedies of this class employed in the horse.

Having gone at some length into the general principles by which the diseases of the horse are to be combated and overcome, we shall now proceed to notice these diseases *seriatim;* but our limited space will only permit us to adopt the most concise method, and point out the principal symptoms that belong to each malady, without attempting to detail the almost endless variety in the order as well as the severity with which these symptoms appear. We select, in the first place, the *diseases of the chest* and air-passages, as being some of the most frequent and important, first, however, making a few observations on the structure of the parts. The passage for the air to and from the lungs is effected by a long tube, called the *trachea* or *windpipe*, composed of a great number of cartilaginous rings, connected together by strong elastic membrane. Thus constituted,

The windpipe.

The larynx.

the channel is preserved in whatever position the neck may be placed. The upper part of this tube is called the *larynx*, and is formed of various singularly shaped cartilages, guarded by a valve, called the epiglottis, which is always open except in the act of swallowing. These cartilages are moved by numerous small muscles, and are connected by them with the *pharynx*, or food-bag immediately above, so that the entrance to the stomach and that to the lungs, though distinctly separate, are yet situated close together, and are often involved in the same disease. The horse breathes only through his nostrils, which are wide and capacious for the purpose; and there is a fleshy membrane, called the *velum palati*, which, attached to the palate-bone above, falls down on the dorsum of the tongue, and closing the back of the mouth, is only raised in the act of swallowing. In man and carnivorous animals this soft palate is shorter, and does not prevent breathing through the mouth. All these parts, in common with the mouth and the nostrils, are very liable to disease, and are lined with a mucous membrane, which, at the larynx, is endowed with a high degree of sensibility by means of several nerves.

Catarrh.

CATARRH, or *cold*, as it is usually termed, consists of inflammation of the mucous membrane just spoken of: that lining the nostrils is generally first affected, and thus sneezing is one of the earliest symptoms. Cough and sore throat follow, with fever, either slight or more severe.. Catarrh may either be very slight or very severe, but it is usually more serious than in the human subject: very frequently it becomes epizootic, and attacks many animals at the same time. In the first stage, the discharge from the nostrils is watery, but sometimes there is none at all; it afterwards becomes thick mucus, which is sometimes very considerable, and gradually ceases as the animal gets better.

Treatment.—Bleed moderately, unless the symptoms are very slight or the horse very weak; rub some blistering liniment on the throat and between the jaws.

Liquid Blister.

Cantharides, powdered . . .	3 drs.
Hartshorn	4 oz.
In a fortnight strain and add	
Olive oil	4 oz.

Keep the body warm and the stable cool; give bran mashes, carrots, or green food, and a little walking exercise daily, unless a loose box can be afforded. If the bowels are anywise costive, give two or three drachms of aloes, and the following cough-ball daily:—

Cough Ball.

Digitalis	½	dr.
Camphor, powdered . . .	1	,,
Tartarized antimony . . .	1	,,
Nitrate of potash	3	drs.
Linseed meal	1	dr.

To be made into a ball with Barbadoes tar.

Repeat the blister if necessary, and, in severe cases, insert a seton under the throat, and steam the nostrils by means of a hot mash and a nose-bag. In epidemic cases the treatment should be pretty nearly the same as above advised; but, as there is generally greater debility present, the depletive measures must be practised with caution, and it will often be advisable to give a few tonic or condition-balls after the inflammatory symptoms are removed.

Tonic Condition-ball.

Powdered ginger	1	dr.
,, gentian	2	drs.
,, camphor	1	dr.
,, sulphate of iron . .	2	drs.

To be made into a ball with linseed meal.

Strangles.

STRANGLES is a disease to which most young horses are liable, between the ages of two and five. The symptoms are, in addition to those of catarrh, a phlegmonous swelling under the jaws, which generally terminates in an abscess, and which it is essential to open as soon as it points. This disease is generally more severe in horses that have been in work some time before it appears, but it is usually followed by an improvement of the health and spirits.

Treatment.—We should avoid bleeding if possible, but in other respects adopt the same treatment as in catarrh, repeating the blister several times. When the glandular swellings remain hard and do not suppurate, it is called, in horseman's phraseology, bastard strangles, and the ointment of iodide of mercury should be repeatedly rubbed into the part.

Iodide of mercury	1 dr.
Lard	1 oz.

To be well incorporated.

Sometimes there is a disposition to form abscesses in various parts of the body, and the disease proves tedious and troublesome; and if abscesses form internally, death is occasionally the result. Shivering fits are often present, and the symptoms are very deceptive. Tonics are here demanded. Catarrh unsubdued often brings on—

Bronchitis.

BRONCHITIS, which is inflammation of the air-passages of the lungs. This disease may arise from extension of the inflammation along the course of the mucous membrane, or it may be the primary disease; for it should be observed that the windpipe, on reaching the chest, divides and subdivides into numerous ramifications, which terminate in minute air-cells. These air-passages are cartilaginous in their structure, and lined with the same mucous membrane as the throat and windpipe. Bronchitis is a severe and dangerous disease, and its symptoms are often very deceptive. We have most of the symptoms of catarrh, but the cough is weaker, the pulse is increased in frequency, and the respiration somewhat disturbed; the appetite is considerably impaired, and the membrane lining the eyelids and nostrils inflamed. The discharge from the nostrils is copious, and white, or sometimes yellow; the legs are usually of their natural temperature; and the horse does not refuse to lie down, although he prefers a standing posture. If the case gets worse, the pulse becomes quicker and weaker; the breathing short, quick, and catching; the discharge from the nostrils somewhat offensive, and occasionally of a dark colour, or streaked with blood. Sometimes this disease is so severe from the first that the membrane lining the air-passage becomes of a dark red, and afterwards of a green colour, and the dsicharge is entirely suppressed: all the symptoms are of the worst character, and death marks the animal as its own from the very onset of the disease; and afterwards the membrane of the air-passages is found of a deep green colour.

Treatment.—Avoid aloes or other purgatives as we would poison. If the bowels are really costive, give care-

Veterinary Art.

fully half a pint to a pint of linseed oil; bleed according to the state of the pulse and the principles we have laid down under the head of blood-letting; repeat the bleeding once or twice in twelve or twenty-four hours, but venesection must not be too copious; blister the throat and the brisket, and sometimes the sides, and insert setons in the chest; steam the head; keep the body warm and the stable cool; bandage the legs; give the fever-ball twice a-day for several days, and when convalescent, the condition-ball a few times.

Structure of the lungs.

PNEUMONIA, or inflammation of the substance of the lungs, is not a rare disease in the horse. The *lungs* are composed of the air-tubes and cells we have spoken of, and a vast number of veins and arteries, both large and small, the whole being connected together by cellular membrane called *parenchyma*, and covered externally by a serous membrane, which also lines every other part of the chest. These light spongy bodies are divided into several lobes, and fill accurately every part of the chest not occupied by other organs, expanding and contracting with that of the thorax. They float readily when placed in water, and are but a few pounds in weight, and of a pale pink colour. Their office is, as we have seen, to admit simultaneously a large quantity of air and of blood, and by exposing them to each other, separated only by a very thin membrane, a mutual change and exchange takes place in both the air and the blood; the latter acquires oxygen, loses carbonic acid gas, and becomes red; the former loses oxygen, acquires carbonic acid gas, watery vapour, and becomes warmer and lighter.

The horse being an animal whose utility is owing, to a great extent, to his capability of performing great exertions, and thereby calling largely on the lungs for the extra performance of their natural functions, we cannot be surprised that these organs, so often unduly exerted, should be liable to derangement and disease.

Congestion of the lungs.

We notice two varieties of inflamed lungs: one which can scarcely be so called, as it is rather *congestion* than inflammation, arises from over-exertion, or a plethoric state of the system. When it becomes fatal, the lungs are found quite black, from every vessel being loaded and distended with impure blood, thus producing suffocation. The *symptoms* can scarcely be mistaken: the breathing is rapid and distressed in the extreme; the pulse very rapid, small, and weak; the limbs cold; the appetite lost; and the membrane of the nostrils very highly injected; and it is often fatal in twenty-four hours, or less.

Treatment.—Give a diffusible stimulant, hand-rub and bandage the legs, and as soon as the pulse becomes stronger and more perceptible, bleed with the finger on the pulse. Employ counter-irritation and febrifuge medicine. We sometimes meet with cases in which, with the most rapid and distressed respiration, the pulse is strong and hard, as well as rapid. In such instances we shall be able to employ with advantage very copious venesection; six or seven quarts of blood will not be too much to abstract. These cases seem to border between that we have described and the true—

Pneumonia.

PNEUMONIA, which may be produced by over-exertion, or the heated body being suddenly or too quickly cooled, producing re-action, or exposure to cold; or, still more frequently, by a stable too hot and confined. It may also follow the congestive pneumonia previously spoken of.

The *symptoms* sometimes are very obscure, leaving it somewhat doubtful whether the lungs are really affected, and which can only be positively ascertained by means of *auscultation*, or applying the ear to the chest. In these obscure cases the inflammation is usually confined to a portion of the lungs; the ear will detect the absence of the usual respiratory murmur in the affected part, which thus gradually becomes condensed and impervious to the passage of air. This disease is frequently preceded or attended at its commencement by a cough, which, however, does not increase, but rather diminishes. The appetite becomes impaired, the animal appears out of sorts, and, if the pulse is examined, it will be found somewhat accelerated, and the respiration perhaps doubled, and attended with a sort of catch. In this stage it may be considered as *sub-acute*, and so it may continue until relieved by treatment; but more frequently in a few days it assumes a new form, in which the appetite is nearly or totally gone, the respiration treble or quadruple that of health, being from thirty to sixty in a minute, the pulse from sixty to ninety, and sometimes full and distinct, at others small and weak, presenting in different cases very different characteristics. The legs feel cold, the mouth hot and clammy, and its secretions often offensive. If the animal gets worse, these symptoms are all increased, the pulse becomes quicker and weaker, and the respiration rivalling it in rapidity; and thus the disease may go on, occasionally perhaps presenting slight gleams of hope which prove delusive, and in the course of five or six days terminates fatally. The *post mortem* appearances are those of *hepatization* or condensation of the greater portion of the lungs, which is impervious to the air, and sinks in water. White lines and knots are often found, and sometimes tubercles and abscesses. In cases where death supervenes in a very few days, and there is yet considerable hepatization, it denotes previous disease, either of a chronic or acute character. In some instances we find the lungs in a state approaching to gangrene, the smell very offensive, and the parts still pervious, full of a brown sanious fluid: some portion of the lungs is usually black, like that in the previous disease, which part is generally that last attacked, for this congestion or black state of the lungs, instead of denoting long standing disease, as used to be supposed by farriers, actually proves the contrary.

Treatment.—Bleeding is certainly the sheet-anchor; and for the principles by which it should be regulated we must refer to the article on Blood-letting, contenting ourselves with observing here that it should be as copious as possible, the first bleeding particularly. If the pulse is at the outset weak or small, we cannot do better than administer two ounces of spirit of nitrous ether in half a pint of water, or, if the bowels are costive, half a pint to a pint of linseed oil; and if this should have been delayed till after the bleeding, and the blood should appear of a dark colour, it may then be given with advantage. We may afterwards resort to sedative and febrifuge medicine, administering a ball two or three times a-day. White hellebore, digitalis, extract of belladonna, calomel in combination with opium, have all been recommended and employed. They have each their peculiar advantages, which must govern their selection. The former, perhaps, is one of the most powerful, but requires very careful watching, so as not to push it too far.

Sedative Ball.

White hellebore, powdered . .	½ dr.
Or extract of belladonna . .	2 drs.
Or digitalis	1 dr.
Or calomel 1 dr. with opium .	½ dr.
Nitrate of potash	2 drs.
Tartarized antimony	1 dr.
Linseed meal	2 drs.

Treacle to form a ball, and one to be given twice a-day.

Counter-irritation is an important addition to our treatment, and the blister is most useful, as producing the most speedy effect. In a very severe case it is difficult to get a blister to act properly, but it is more likely to produce a proper effect on the brisket than on the sides. Setons and rowels may be also conjoined, and, in subacute cases, preferred as producing a more lasting effect; and they will be found particularly useful if the case has become chronic. If we have reason to fear that hepatization has commenced in the lungs, it will be advisable to employ the preparations of iodine both externally and internally; half a scruple of the iodide of potassium may be added to the sedative or other ball, and the ointment of iodide of mercury may be employed externally. When the inflammatory action appears pretty well subdued, and much debility remains, it will be advisable to administer a few tonics, the best combination for which will be the sulphate of iron, ginger, and gentian, a drachm and half of each, made into a ball with treacle, and given once or twice a-day.

Pleurisy. PLEURISY or PLEURITIS, which is inflammation of the pleura or lining membrane of the chest and lungs, used to be considered as never occurring but in connection with pneumonia. More accurate and extended observation, however, has satisfactorily shown that, although not so frequent as the latter, and though often combined with it, it yet does occur in many instances as a pure disease. Though many of the symptoms resemble those of pneumonia, it may be readily distinguished from it by the much stronger and harder pulse, the occasional exhibition of acute pain, causing the horse to paw and even lie down, and the tenderness evinced on pressing the sides. The inflammatory type is more strongly marked, but there is much less external coldness and less debility. The breathing is less difficult, but painful and variable; the inspiration is quick, but the expiration slow; the membrane of the nostrils is not injected as in pneumonia, and the symptoms altogether are more changeable. The appearances after death (which, when the case is fatal, often takes place in seven or eight days, unless the disease becomes chronic) are those of extensive derangement of the membrane affected, which is often in a gangrenous state, portions of the lungs adhere to the chest, and flakes of lymph are thrown out. Sometimes there is no deposition of fluid, but more frequently there is a considerable quantity secreted, amounting to many gallons, in one or both cavities. When there is much water, the other diseased appearances are less considerable, as this *hydrothorax*, as it is called, is the result of the inflammation, and the effect of the expenditure of its force. When water is forming, the symptoms are moderated, purging sometimes comes on, and on applying the ear to the chest, the usual respiratory murmur cannot be heard, but sometimes on moving the horse, the gurgling of the water can be detected, and the chest, when gently struck, gives out a dead sound.

The *Treatment* must be somewhat similar to pneumonia—bleeding must be employed, if possible, to a still greater extent, and it will be found that there is a greater ability for bearing it. It must be repeated if required. Counter-irritants and sedatives should also be employed. Scruple doses of opium will be a useful addition to the sedative ball, and the other treatment must resemble that which we have advised for pneumonia. If hydrothorax is strongly suspected, or proved to exist, we should abstain from further bleeding, as this is calculated to encourage the watery secretion. Tonics should then be given with diuretics, such as sulphate of copper one to two drachms, with ginger and gentian, in similar quantities, made into a ball with Venice turpentine. If the water appears to exist to a large amount, the operation of *paracentesis*, or tapping, should be employed. The trochar being plunged into the chest, between the eighth and ninth ribs, as low down as possible, the water will escape through the canula, which is left in the wound till all is evacuated. The operation should be performed on both sides, unless it is evident that the water is confined to one cavity, and generally requires to be repeated. Its success will depend very much on the amount of disease that may exist independent of the water on the chest; for when confined to the deposition of serum, it is much more likely to be successful.

Pleuro-pneumonia is the complication of inflammation of the lungs with that of the pleura, and though not so common as the former, it is more so than the latter disease. The symptoms are more obscure than either, though partaking of the character of both, and the result is still more frequently fatal. The *Treatment* must be in great measure similar to that we have advised, regulated, however, by the peculiar symptoms, and the predominance of those of the one disease or the other. Pleuro-pneumonia.

The HEART is rarely the subject of inflammation, and fortunate is it that it is not so, for as it is the organ which is called upon for increased exertion in all cases of fever or inflammation, were it much disposed to inflammation itself, the more serious diseases would then be far more dangerous than they really are. CARDITIS, as inflammation of the heart is termed, is always connected with other disease, and seems to arise from the undue exertion of the organ. When the heart is affected, it increases the danger of any other co-existing disease. Diseases of the heart. Carditis.

PERICARDITIS, or inflammation of the heart-bag, is much more common; it often accompanies pleurisy, and occasionally pneumonia, and sometimes rheumatism; it nearly always terminates in the deposition of water and lymph in the pericardium (*hydrops pericardii*) which by pressing on the heart oppresses it considerably, and at length chokes its action. The presence of water in the heart-bag considerably modifies the other symptoms, and renders the pulse weak, vacillating, and sometimes intermittent. It is very important to detect the existence of pericarditis when it occurs in conjunction with pleurisy or pneumonia, as the same amount of blood-letting cannot be borne, nor is it advantageous. Pericarditis. Hydrops pericardii.

HYPERTROPHY, or enlargement of the sides of the heart, occasionally exists either with or without dilatation of its cavities. Sometimes there is simply an increase Hypertrophy.

of its muscular parietes, at others an enormous growth of a cancerous structure, which may chiefly appear on the exterior, or, as in a case which has occurred in the writer's practice whilst writing the present article, in one of the cavities. In the case referred to, that of a thorough-bred filly, a fungous substance actually occupied three-fourths of the right ventricle, and after occasioning some constitutional derangement for some time, at length produced sudden death. The disease is usually accompanied by a peculiar pulse, quick, full, and strong, but with a laboured action; the carotid arteries may often be seen to beat as they rise from the chest; the heart palpitates, and is often irregular and intermittent in its action. The disease, though frequently fatal, is best treated by moderate bleeding and sedatives, of which opium is the best; and if the horse apparently recovers, his work should be very moderate.

Cancer of the heart.

Rupture of the heart.

Rupture of the heart sometimes, though rarely, occurs. In most affections of the heart, the appearances are very deceitful; there being no pain of any amount or threatened suffocation, the appetite is often but little impaired, and the respiration by no means hurried. Thus, though there is a somewhat haggard appearance of the horse, the attendants are disposed to disregard it, or ascribe it to temporary causes, and the animal is often not considered to be ill until he is actually at the brink of death.

Spasm of the diaphragm.

Spasm of the Diaphragm has often been mistaken for disease of the heart: a loud thumping noise has been heard, which appears to come from the heart; but it is found that it can be heard and felt at other and different parts of the body, and the noise does not synchronize with the pulse, being less frequent; it appears on examination to correspond with the breathing, and to be owing to the violent spasmodic action of the diaphragm. It is generally produced by over-exertion, and particularly if taken on a full stomach. The treatment should consist in administering an ounce of tincture of opium, and two ounces of spirit of nitrous ether, in a pint of warm water. After which it will be proper to bleed more or less severely, according to the strength of the pulse. If the bowels are costive, oily laxatives should be given with injections. The anti-spasmodic may be repeated in a few hours. This treatment will generally prove successful.

Rupture of the diaphragm.

Rupture of the Diaphragm now and then occurs: it is produced by excessive exertion or coughing, and is attended by great distress, rapid and very peculiar respiration, and is invariably fatal in a few hours, or in several days, according to the extent of the rupture.

Besides the diseases of the respiratory organs which we have noticed, there are several others which, though not fatal in the result, are yet so serious in their nature as greatly to interfere with the utility of the animal, and considerably impair his value. The first we shall notice is Broken Wind, as it is popularly and expressively designated. The symptoms of this disease are a peculiar and well-marked breathing, which is not only quick, but attended with a prolonged expiration, and a double action of the abdominal muscles. The appearances of the lungs of broken-winded horses sufficiently explain this peculiar respiration, for we find that they are much larger than usual, but without increased weight; the size being occasioned by air, which has escaped from the air-cells, and become infiltrated under the membrane. The disease then consists of a rupture of the air-cells, and though the air can be drawn in with ease, yet there is a difficulty in expelling it, as might be expected, and thus the double expiratory effort. Broken-winded horses are of course incapable of performing the same amount of exertion as before, but their ability depends on the amount of the injury, and the mode and nature of the feeding. The lungs being to a certain extent at all times inflated with air, much of which is in a situation where it cannot be usefully employed, it is evident that the horse must breathe quicker than usual, in order to inhale in a given time the requisite amount of atmospheric air, which distending still more the inflated lungs is with much difficulty expelled, and requires a double and long-continued effort to accomplish it. When the case is very bad, the horse rarely appears in good condition, and there is often much external coldness manifested: the latter symptom may arise from a less quantity of oxygen, one of the sources of heat, being absorbed, and the former from the indigestion which is generally present, and which also occasions the great flatulency that is often exhibited. A peculiar short dry cough is usually present, which is greatly increased if the horse eats foul or dusty food. There is generally an unusual dryness, and sometimes a thickening of the membrane that lines the air-passages, and which appears to be the immediate cause of the cough. Though broken wind is not curable—though it is impossible to restore the ruptured air-cells—yet very much can be done in the way of treatment, and this must principally consist in avoiding all dusty and unwholesome provender, and giving the horse nutritious food in a small compass, in order that the stomach may never be overloaded so as to press too much on the chest. It is more particularly essential that the horse should not work on a full stomach. Green food may be given in the summer, and carrots in the winter; but he should not be turned out to grass or straw-yard, but kept in as high condition as possible. Broken wind usually comes on gradually, but it sometimes occurs suddenly; and the writer has several times been requested to attend cases supposed to be inflamed lungs, but which he found was broken wind, unexpectedly produced: sudden and severe exertion, on a full stomach, was in each case the exciting cause.

Broken wind.

Thick Wind, though frequently confounded with, is yet very different from, that just described. The respiration is greatly increased, but without the distress of pneumonia, or the double action of broken wind. It is occasioned by a partially impervious state of the air-passages, which may be caused either by the condensation of the lungs from pneumonia, or a thickening of the parieties from chronic or sub-acute inflammation, which may have been mistaken for a common cold, and passed unheeded. The space for the air being thus limited in extent, more frequent respiration is necessary, and which is more particularly the case after and during exertion. It is often, though not always, attended with a cough; but there is not such dryness of the membranes as in broken wind. The same mode of management should be adopted as in the former disease.

Thick wind.

Chronic Cough is closely connected with the two diseases last described; it often accompanies, and frequently precedes them, but it may occur altogether unaccompanied by any impairment of the wind. In such instances it is the effect of catarrh and sore throat, and such horses are more subject to take cold than others,

Chronic cough.

and then the cough becomes increased. In many cases it is impossible to decide merely from hearing it that the cough is chronic; but the horse, when it is not very bad, usually coughs several times on first being trotted in the morning, and sometimes it does not return throughout the day. It appears to arise from a thickening of the mucous membrane of the larynx or other air-passage, and a consequently altered state of its secretions, which become thicker and more viscid. The advice we have given as to the previous diseases is in most respects applicable to this; but we may in addition derive some benefit from stimulating the throat externally, and administering occasionally a cough ball. It is very requisite to adopt the most active measures whenever a horse with chronic cough becomes affected with catarrh or sore throat, in order to prevent further alteration of structure.

Roaring.

Roaring is another disease of the larynx of frequent occurrence, and of serious import, affecting the most valuable horses, and often reducing their value 80 or 90 per cent. It derives its appellation from the peculiarity of the noise made in breathing, this noise being occasioned by the air rushing through a contracted channel. Anything, therefore, which diminishes the natural calibre of the larynx or wind-pipe may occasion roaring; and thus we find it proceeds from a variety of causes, such as a contraction of the wind-pipe itself, bands thrown across it, thickening of the membrane of the larynx, ossification of its cartilages, absorption or attenuation of the muscles which open the larynx, and distortion of both wind-pipe and larynx, or either. The noise is not heard when the horse is at rest, or at moderate work, but only when the respiration is increased by exertion. There is of course a great variety in the degrees of roaring; some horses make a noise as soon as they are trotted, others not until they are put to the top of their speed. This depends to a great extent on the amount of impediment that may exist, and partly on the condition and capability of the horse for performing fast exertion. Thus the same degree of obstruction that would make a heavy horse roar in the trot, will perhaps only occasion the noise in a thorough-bred horse during a gallop. Different degrees of obstruction occasion variations in the sound produced; and thus we have the names, whistlers, wheezers, and high-blowers, given by horse-dealers to horses that roar. Independent of the nuisance occasioned by the disagreeable noise, there is an incapability of performing the same exertion as before, in consequence of the obstruction preventing a sufficient quantity of air from entering the lungs in a given time, and sometimes suffocation is produced in consequence.

Treatment.—As a general rule we may state that there is no cure for roaring. It is only when there is actual sore throat, or inflammatory action going on in the larynx, or morbid changes very recently formed, that we can afford relief; but in such instances we often can do so, to a considerable extent, by the continued application of iodine combinations externally at the region of the larynx, assisted by the administration of hydriodate of potash internally, at first perhaps combined with calomel, and afterwards with vegetable and mineral tonics. The horse should be kept in the highest condition, and not allowed to overload his stomach previous to exertion. It is customary sometimes to place a strap, so as to press on the nostrils, which diminishes the noise in bad roaring. This, however, does not enable the horse to perform more labour, but it merely lessens the noise by preventing the admission of more air than can readily pass through the contracted larynx. In the greater number of cases there is neither cough nor imperfection of the wind attending roaring; when the former exists, it denotes that the roaring proceeds from the morbid depositions produced by sore throat, &c., or laryngitis.

Abdominal viscera.

Diseases of the Abdominal Viscera.—It will be convenient to preface this part of our subject by a few observations on the comparative structure of the organs, of the diseases of which we intend to speak. Compared with man and carnivorous animals, the *abdomen* of the horse is of large volume, though for evident reasons comparatively smaller than that of the ox or sheep. The nature of his food requires considerable size in the intestines, and these of course demand a corresponding cavity for their reception; and thus we find that horses with very small bellies, though willing and free, are incapable of long-continued exertions, and carry very little flesh in their work.

The abdomen is lined by a dense, strong, and elastic cellular membrane, called the *peritoneum*, which is also reflected on the viscera, and secretes a watery vapour or fluid, which lubricates every part, and enables the almost continual motions of the bowels to be executed without injury. The lower part of the abdomen is occupied by the large intestines when the horse is in a standing posture, and the small guts are above them.

The stomach.

The *Stomach* of the horse is very small compared with most other animals, and usually contains about three gallons; it is however a strong muscular cavity, capable of considerable distention: it is situated on the left side, and when full, presses on the diaphragm, and mechanically impedes its action. On cutting into the stomach, we find that one half is lined by a white cuticular and almost insensible coat, and the other half by a red villous and very sensitive membrane, which secretes the gastric juice by which digestion is in a great measure effected. It has two openings,—one in the cuticular coat, called the cardiac orifice, which receives the food from the œsophagus, and the other in the villous coat, called the pyloric orifice, through which the food passes into the intestines.

The intestines

The *Intestines* of the horse are very spacious and of great length, being no less than ninety feet, the greater part of which length is formed of the small intestines. They are composed of three coats, the peritoneal, which we have spoken of; the muscular, by which its snake-like movements are effected, and the mucous, which secretes a mucous fluid for its protection. The small intestines contain about eleven gallons, and the large eighteen: the chyle is principally absorbed in the former, by the small vessels called lacteals, whose mouths open on the inner coat of the intestines.

The bowels are fastened to the spine by a strong membrane, called the *mesentery*, which serves as the medium of communication of the numerous vessels and nerves which pass to and from them. The inner surface of the intestines is of vast extent, exceeding that of the surface of the body: the large intestines are puckered by strong bands, which serve to give support and at the same time increases the interior surface. The small intestines are called the *Duodenum*, the *Jejunum*, and the *Ileum*; but the distinction is quite arbitrary. The large ones are, however, with greater reason dis-

tinguished as the *Colon*, the *Cæcum*, and the *Rectum;* the former is the largest, containing no less than twelve gallons; the second is the chief receptacle for fluids, and has a blind extremity which first appears on opening the abdomen; the last is the smallest and most posterior, from which the fæces are expelled by its strong muscular coat.

The liver. The *Liver*, the largest gland in the body, is of a reddish-brown colour, and irregular figure, being divided into lobes. It is fastened to the diaphragm, and kept in its situation towards the right side by strong portions of peritoneum. It is supplied with arterial blood for its own nourishment, but it separates the *bile* from impure venous blood, with which it is furnished by some large veins. The bile. The bile thus formed passes into the intestines at once, there being no gall-bladder in the horse, through the hepatic duct. The quantity secreted by the horse is relatively much greater than in man, being no less than 37 lbs. in the course of 24 hours. We are indebted to Professor Liebig for some new and important ideas with regard to the use of the bile. It used to be supposed that its office was confined to the digestion of the food, and that it stimulated the intestines to the performance of their functions; but it appears that its principal use is to separate the carbon of the transformed tissues from the venous blood, and convey it to the bowels, where the greater portion is again absorbed and taken into the system; it thus furnishes carbon for uniting with the oxygen of the atmosphere, by which union the heat of the body is supplied and maintained. The bile contains 90 per cent. of water, the remainder consists for the most part of carbon, besides which there is soda, which also re-appears in the blood, and finally escapes from the system with the urine. Thus it is that diseases of the liver generally occur in hot weather, when the system is loaded with carbon, for then, there being less demand for heat in the body, there is less oxygen inspired, less carbon excreted by the lungs, and more conveyed and re-conveyed to the liver; and thus in inflammation of the liver the blood is often loaded with fat and oil.

The pancreas. The *Pancreas*, or sweetbread, lies close to the spine, and near the left kidney; it secretes a fluid resembling saliva, which is discharged into the intestines close to the hepatic duct. It serves to dilute the contents of the bowels, and furnish it with soda.

The spleen. The *Spleen* is a peculiar organ loosely attached to the stomach: it does not secrete any fluid, but appears to be a reservoir for blood.

The kidneys. The *Kidneys* are two glands closely attached to the lumbar vertebræ, and the psoas muscles. They are largely supplied with arterial blood, from which they separate the urine, which is conveyed to the bladder by long tubes called the ureters. The urine, it is well known, abounds with ammonia, a compound consisting largely of nitrogen, which is derived from the transformed tissues arising from the waste the body is continually undergoing. Its properties are alkaline, whilst that of carnivorous animals possess acid properties.

Gastritis. GASTRITIS, or inflammation of the stomach, is a rare disease in the horse, and when it does occur it is most frequently produced by poison; it now and then, however, appears as a natural disease. Its usual symptoms are a dull, heavy appearance, loss of appetite, hot mouth, swollen eyelids, abdomen enlarged, bowels rather costive, pulse oppressed and ranging from fifty to sixty. This stage is sometimes followed by one of excitement, in which the pulse is increased in frequency, and the febrile symptoms are more marked; and this stage may be again succeeded by stupefaction. There is not the acute agony of inflammation of the bowels, but it is evident that there is a constant pain of a more subdued character. The disease may be produced by anything that disturbs the digestive functions, and it is attended with considerable danger.

The *Treatment* must consist of copious blood-letting, oily laxatives, injections, plenty of diluents, such as linseed tea, and stimulating externally the region of the stomach, and afterwards administering vegetable tonics. If there is reason to suspect that the animal has had poison administered, we must endeavour to ascertain the nature of the poison, and apply without delay the best antidote. If arsenic has been taken, lime-water and mucilaginous liquids, in large quantities, should be given, and bleeding avoided, as being calculated to encourage absorption, but endeavours should be made to subdue the inflammation by other means. If corrosive sublimate has been taken, the white or albumen of eggs should be given suspended in water, as this renders the sublimate insoluble. If the preparations of lead have been given, Epsom salts with linseed oil and gruel should be administered. For sulphate of copper the best antidotes are soap, oily purgatives, and gruel. For the strong acids, chalk, magnesia, and soap, and large quantities of liquids should be given. Poisons. When death takes place, we usually find, if a mineral poison is the cause, that the stomach as well as the intestines are eroded, ulcerated, and inflamed. If gastritis proceeds from natural causes, and terminates fatally, the stomach is greatly inflamed, and a thick coat of blood is sometimes effused under the mucous membrane.

Inflammation of the stomach may exist in a sub-acute form, but very rarely; and cancer and scirrhus in this viscus are still more seldom met with.

Stomach staggers. STOMACH STAGGERS, or the mechanical distension of the stomach with food, is now a very rare disease compared to what it once was. This favourable alteration may be attributed to the much better system now pursued in the feeding of horses; they are not kept without food so long as used to be the case with agricultural and waggon-horses. Indigestion may either be the cause or the consequence of the distension. When the stomach is empty, and a large quantity of food half masticated is hastily consumed, indigestion is the natural consequence; but the powers of the stomach may be sufficient to overcome the indigestion, or it may induce the torpor and other symptoms of stomach staggers. On the other hand, indigestion occasioned by deleterious substances may precede, and render the food productive of distension. Some years since this disease proved dreadfully fatal in Wales, and produced great havoc amongst the horses employed in the mines; but in England the attacks have usually been solitary or confined to a few cases. It was, however, of somewhat frequent occurrence on undrained moors, and was there ascribed to eating the weed called ragwort, or stagger-wort, as it was locally denominated.

The *Symptoms* are, great heaviness and drowsiness: the horse rests his head against the manger, or forces it against the rack or the wall, standing with his fore legs much under him. These symptoms would appear to denote disease of the brain, but there is such an intimate nervous communication between this organ and

Veterinary Art.

the stomach, that it becomes affected by sympathy. The bowels are costive, the abdomen greatly distended, the urine high coloured, the membranes of the nostrils and the mouth often of a yellow tinge; and sometimes there is a twitching of the muscles of the chest. The breathing is not increased, and the pulse for some time does not greatly exceed the natural standard. There is little or no appetite, but the food is taken and partly masticated, and dropped again from the mouth. These symptoms go on increasing, and the animal may die paralyzed or convulsed, or tetanus may supervene; and sometimes the symptoms of the most violent brain fever may carry off the animal.

The *Treatment* must be regulated by the symptoms and condition of the horse. If the abdomen is greatly distended and feels hard, we may rightly conjecture that the stomach is loaded with food; if, on the other hand, the abdomen is of moderate size or tucked up, then the cause may be in the brain, or there may be indigestion, but without much mechanical distension. In the former case our utmost efforts must be employed in relieving the overloaded viscus. Croton oil, 30 drops may be given with a pint of linseed oil and 2 drachms of ginger; and moieties of the two latter medicines may be repeated several times. Injections should be thrown up frequently so as to relieve the bowels. Bleeding may be practised, but in moderation, and the abdomen may be fomented externally. Spirits of nitrous ether and the liquor ammonia acetatis, an ounce of the former and two of the latter should be given twice a-day; and when the bowels are relaxed, vegetable tonics will be found advantageous. If the symptoms of excitement should succeed those of torpor, profuse blood-letting may be had recourse to. If indigestion appears to be present, but without distension, we must then endeavour to restore the tone of the stomach by mild laxatives, diffusible stimulants, and vegetable tonics.

Colic or Fret

Spasmodic and Flatulent Colic—*Fret*—*Gripes*.—These various terms are employed to designate a disease which is very common in the horse. It may proceed from indigestion, drinking cold water, or eating green food. There are several varieties of the disease; for instance, ***Flatulent colic***, which is the most frequent, is distension of the stomach or bowels with the gases produced by the fermentation of the ingesta, and often arises from eating green food. *Spasmodic colic* is violent spasms or contractions of the muscular coat of the bowels, and often proceeds from a large draught of cold water, particularly if it be hard. *Stercoral colic* arises from indigestion and the mechanical interruption caused by an accumulation of food. The *symptoms* of the two former are pretty much alike, and are characterized by the exhibition of the most violent and acute pain; the horse paws his litter, lies down, rolls on his back, looks round on his sides, rises again, and continues suffering the most violent agony for some time, with occasional intermissions of ease. In flatulent colic the abdomen is distended; in spasmodic, it is not. There is generally an incapability of passing the urine, which induces the attendants to suppose that the pain arises from this inability to stale; but this is not the case, for sometimes the horse is relieved from the most violent pain in a very few minutes, and then, the stomach and bowels being eased, the horse stales readily, and this is one of the earliest and most decided symptoms of improvement. The neck of the bladder probably sympathizes with the bowels. The pulse for some time is but little, if at all, increased in frequency, and if it is so during a paroxysm, it quickly subsides on its remission. This is very essential to observe, as it affords the most important means of discriminating between colic and inflammation of the bowels; but, in addition, we may observe, that in the latter disease there are no intervals of ease, and there is often coldness of the extremities. In stercoral colic the symptoms are by no means so violent, but more constant and long-continued.

The *Treatment* must consist in the immediate administration of an anti-spasmodic; some give spirits of turpentine with linseed oil, but, though often successful, there is some danger of producing inflammation, which it is better to avoid, or of inflaming the throat if the horse retains it there for some time, as is frequently the case in this disease. Hartshorn is subject to the same objections; in the absence of other agents, however, they may each be given, and then the dose of the former is from two to four ounces; and the latter one or two. In the same manner a quarter of a pint of brandy or gin, or one ounce of ginger dissolved in water may be often successfully employed. A better remedy than any of these, however, is the tincture of opium, an ounce of which may be combined with one of tincture of myrrh or valerian and two of spirit of nitrous ether; or, if there is flatulency, six drachms of sulphuric ether, and given with a pint of tepid water. If relief is not obtained in the course of an hour, the dose should be repeated, and the horse bled, and that and any subsequent doses had better be given with a pint or more of linseed oil. In stercoral colic we must not expect immediate relief, and it is better to bleed early and give large doses of linseed oil with tincture of opium, repeating the dose every three or four hours, and assisting the action of the oil by frequent and copious injections of warm water. By this treatment we shall generally succeed in removing the obstruction and the pain. There is much less danger attending the profuse purging which afterwards succeeds than if it is produced by aloes; plenty of thick gruel must, however, be administered, to which a few drachms of gentian and ginger may be added.

Enteritis.

Inflammation of the Bowels (*Enteritis*).—It is important to distinguish this disease from that last described, as there is some essential difference required in the treatment. It consists of inflammation, principally, of the muscular coat of the bowels, and it causes the most acute and severe pain. The horse lies down, looks round at his flanks, groans, sweats, rolls and plunges about, and gets up again, and thus continues with but slight, if any, intervals of remission. There are, in fact, no paroxysms, as in colic; there is no relief from pain, though the agony may not be at all times alike. The extremities soon get cold; there is an absolute loathing of food; the pulse is exceedingly quick; at first somewhat full and hard, but it soon becomes small and wiry; and except at the onset of the disease, the blood is of a dark colour. The causes of enteritis are cold applied to the abdomen, either externally or internally, long-continued and rapid exertion, and indigestible or improper food, or indigestion from other causes.

Treatment.—There is no disease that requires more prompt and energetic attention than this. In the first instance a large opening should be made in the jugular, and if the blood does not flow rapidly, a similar open-

ing on the other side of the neck. With the finger on the pulse, we should abstract as much blood as the animal can bear, continuing the operation till the pulse is scarcely perceptible, by which time from six to eight quarts will probably have been abstracted. The following draught should next be administered—powdered opium a drachm and a-half; tartarized antimony, one drachm; spirit of nitrous ether, one ounce, which having been mixed together, a pint and a half of linseed oil may be added. Injections of warm water should be frequently thrown up, the extremities bandaged with flannel, the warmth having been previously restored by means of hand-rubbing and a liniment of oil and turpentine. The abdomen should be fomented with hot water for a long time together, by means of long woollen cloths held by two men, one on each side of the horse; the cloths should not be very wet, but being wrung by the men, they should be applied to the abdomen for several minutes at a time. The bleeding, if required, should be repeated in the course of four to six hours, and the best sedative will be a ball containing a drachm each of opium and calomel, which may be given every six hours. The horse should be encouraged to drink warm water and tepid gruel, and thick oatmeal or linseed gruel may be given as a drench from time to time. If constipation continue, the oil, in half doses, must be repeated. When the horse gets better, no corn and very little hay should be given for several days, but plenty of bran mashes. He will require much care and attention, and should not be put to his work too soon.

Strangulation of the bowels.

Strangulation of the Bowels sometimes produces symptoms very similar to those we have described under the head of enteritis. It is in fact inflammation of the bowels, but confined to a more limited space. There are various kinds or causes of strangulation—sometimes the guts become entangled and twisted into a knot, at others the mesentery is ruptured, and the part separated forms a noose, through which the bowels pass when empty, and afterwards becoming distended with food or wind, strangulation is the consequence. Sometimes one portion of the intestines becomes insinuated into another, causing *inter-vagination*. These morbid changes may either be the consequence of the violent motion of the bowels in spasmodic colic, or it may arise from accidental or natural causes, which produce all the symptoms that we notice from the beginning. When spasmodic colic becomes fatal, it is most frequently from strangulation of the intestines supervening. The earlier symptoms of strangulation resemble those of colic, but without any remission of pain; it thus differs from enteritis in the rapid pulse, and other marks of inflammation not being present at first, but gradually and fatally developed afterwards. It must be evident, though it is impossible to pronounce decidedly that strangulation has taken place, that when it is so, all treatment will be fruitless.

Hernia, or *Rupture*.—It consists in the escape of a portion of the intestines from the abdomen. When this takes place through the abdominal ring, it is called *scrotal* hernia in the horse, and *inguinal* hernia in the gelding. Sometimes it is *congenital*, appearing at birth, and this may also be the case with abdominal hernia; but it is more frequently produced afterwards by external injury, such as a hook from a cow, which ruptures the abdominal muscles, but not the more elastic skin. Scrotal hernia sometimes becomes strangulated, when the utmost agony is produced, and if relief is not speedily obtained, death is sure to follow. No time therefore must be lost, but the horse being thrown, attempts should be made to reduce the hernia by manipulation with the hands (the *taxis*), a powerful opiate, with blood-letting having been previously employed. If this fails, the scrotum must be opened, the stricture carefully enlarged, the intestine returned, and the testicles removed. In congenital scrotal hernia, the intestine should be returned into the abdomen, and the colt castrated by the caustic clams without cutting into the vaginal sac. Abdominal hernia may often be cured by pressing in the intestines, and tying a strong ligature closely round the skin, which, sloughing off, leaves a cicatrix, which prevents the re-escape of the bowels. In more extensive cases, a cure has been accomplished by cutting through the skin, reducing the rupture, and preventing its return by strong metallic sutures connecting together the lacerated muscles.

Calculi in the intestines.

Large stones in the intestines sometimes produce stoppage, inflammation, and death. Millers' horses are most subject to this disease, and the appearance of the calculi shows that for the most part it consists of the powder from the millstone intermingled with the food; this is taken with the bran, which usually forms a larger portion of the diet of such animals. Horses so affected are frequently subject to colic, but usually get relieved after a while, either with treatment, or by the stone becoming dislodged by the struggles of the animal. The *symptoms* resemble those of colic; but there is obstinate constipation, and if the stone is in the large intestines, as it generally is, unless it is in the stomach, the horse will sometimes sit on his haunches like a dog. He should be copiously bled, and opium, with large doses of oil administered, the former to relieve the pain, and the latter to promote the evacuation of the calculi which, if not too large, may sometimes be accomplished.

Rupture of the intestines.

Rupture of the intestines now and then occurs; the symptoms resemble enteritis of the worst kind, but with greater loss of strength and pulse, and it becomes fatal often in the course of twelve hours; the horse will also sometimes sit on his haunches.

Inflammation of the mucous coat of the bowels is not so common as it used to be, when the enormous doses of aloes, and other purgatives of which we read in old books, were commonly administered. This leads us to the most frequent cause of the disease, which is an overdose of purgative medicine. The horse, either from its vast extent or other causes, is very liable to inflammation of the mucous coat of the intestines. It is indeed one of the peculiarities of the animal, and renders purging a much more serious affair than in man, and occasions a small dose of aloes to be so dangerous in affections of the lungs. There are, however, several stages or varieties of disease in this coat. We may have simple *diarrhœa*, which is purging without inflammation; or *dysentery*, vulgarly called molton grease, in which large flakes and masses of fatty-looking mucus is discharged with the fæces, which may either be hard or relaxed. This disease appears to be subacute inflammation of the mucous membrane. Diarrhœa should be treated with opium, 1 dr., powdered chalk 2 oz., catechu 2 drs., and ginger 1 dr., with wheat-flour gruel, keeping the body warm and comfortable. *Dysentery* requires the oily

Dysentery.

Veterinary Art.

laxative, together with the calomel and opium ball previously advised, with plenty of linseed tea or other diluents.

Super-purgation.

Super-purgation from actual inflammation, is extremely dangerous; it is attended with coldness of the extremities, weakness, and pain; the horse lying down, looking round at his flanks, and feeling greatly distressed; the pulse is small and thready, and the membrane of the eyelids and nostrils of a deep red or orange colour. It is necessary to avoid bleeding, at any rate until the pulse becomes much more distinct and stronger. The following draught should be administered as early as possible. Powdered opium 1 dr., prepared chalk 4 oz., acacia gum 1 oz., carefully dissolved in warm water, and given with plenty of oatmeal gruel, which, alternated with linseed tea, should be often repeated. The legs should be bandaged, and the abdomen fomented with hot water. The medicine, or one half of it, may be repeated, if necessary, in a few hours; and when the purging appears to be stopped, half a pint of linseed oil should be given to prevent constipation, which, as the sequel, is attended with danger. Unless the symptoms can be relieved early, the disease becomes fatal, sometimes in the course of twelve hours; and the inside of the intestines discovers traces of extensive disease, being often completely black. This disease is more frequent than enteritis, and, like it, may be produced by over-exertion and exposure to cold. Some horses are much more disposed to it than others, and particularly those with light carcases.

Peritonitis.

Peritonitis, or inflammation of the peritoneal coat of the bowels, is extremely rare in the horse. When it does occur, it usually proceeds from castration, the inflammation spreading from the scrotum through the abdominal rings, which in the horse continue open to the abdomen, and then it is frequently fatal. It also sometimes accompanies pleurisy, the membrane attacked being the same in both these diseases.

The *Treatment* must be regulated by the symptoms, and should be nearly similar to that advised for enteritis.

Ascitis.

Dropsy of the abdomen is still more rare in the horse; it is the effect of subacute inflammation of the peritoneum, and should be relieved by tapping.

Worms.

Worms.—There are various worms which are found in the intestines of the horse. *Bots* are the larvæ of the gad-fly, of which there are two species, which deposit their eggs on the skin. These eggs are swallowed by the horse, and are hatched in the stomach, where they remain fixed by their hooks for the greater part of the year, and are then excreted with the food, and take the form of the parent fly. They are seldom injurious. The *Teres*, or round worms, as well as the thread-worm *Ascaris*, are very common in horses, particularly in those that are poorly fed, and in bad condition. The latter occasion the most irritation, and are principally found in the cœcum. If the horse appears in good health and condition, it is well to let the worms alone, but if otherwise, we may have recourse to some means for their expulsion. A drachm of tartarized antimony, or six grains of arsenic, combined with vegetable tonics, and given daily for a week, and followed with a pint and half of linseed oil, will often succeed in removing them; or three ounces of spirits of turpentine, with the above dose of oil, and followed with tonics, has also been exhibited with success.

Diseases of the liver.

Diseases of the Liver are much less frequent in the horse than in man, owing probably to the more regular manner in which the former is both fed and worked. If, however, a horse is very highly fed, and very little exercised, the system becomes loaded with carbon, which cannot get relieved through the usual outlet—the lungs, as the horse does not respire sufficiently, nor consequently absorb sufficient oxygen to combine with the carbon that is ready to be excreted. Much of the superfluous carbon is converted into fat; but what cannot be so converted is thrown on the liver, and disease of this organ is the consequence. In warm weather there is much less oxygen required for keeping up the animal heat, and there is consequently less oxygen absorbed, and less carbon expired; thus it is that animals are more disposed to get fat in the summer than in the winter, and more liable for the same reason to diseases of the liver.

Jaundice.

Jaundice, or the yellows, is an extremely rare disease in the horse. There being no gall-bladder, there is less danger of obstruction from gall-stones, or other causes, and therefore the bile is rarely absorbed into the system, colouring the membrane of the eyelids and nostrils with a yellow tinge, which is the principal symptom of the jaundice in the human subject. When the membranes are so tinged, it is generally the consequence of—

Hepatitis.

Hepatitis or Inflammation of the Liver.—The *symptoms* of this disease are less marked than in inflammation of the lungs, but they depend very much on the acuteness of the attack. In the acute variety, we have a quick pulse, ranging probably between 50 and 70, and firm and regular. The respiration is also increased, but without the distressed appearance of pneumonia, and the horse prefers a standing posture, but not obstinately, as in that disease; and as the inflammation advances, he will lie down and get up frequently. The mouth feels hot, and there is no appetite. These symptoms do not all make their appearance suddenly, but the disease has probably been creeping on for days before the horse has been thought to be amiss. The yellowness of the eyelids and mouth, in addition to the other symptoms, testifies the nature of the malady, which is otherwise obscure. It is a very dangerous complaint, and is not unfrequently fatal, and it often occurs in connection with other diseases, and more particularly with the *Influenza*, the danger of which it greatly increases. The sides, and particularly the right, is tender on being pressed, and the fæces are hard and coated with mucus, and sometimes fœtid and purging. When the symptoms are unrelieved, they all become more urgent; the pulse quicker, weaker, and vacillating, and the animal dies in the course of ten or twelve days.

The *Treatment* must be less active than that advised for pneumonia, and particularly with regard to bleeding. From three to five quarts will usually be sufficient at first, and two or three on repeating the operation. The following draught should be given:—Carbonate of potash 2 drs., aloes 2 drs., dissolved in hot water, and then well shaken up with 12 ozs. of linseed oil, and 1 dr. of calomel; to be repeated twice a-day, without the aloes, until the bowels are moderately relaxed, and to be assisted by raking and injections. If there are symptoms of pain, 1 oz. of tincture of opium may be added to the above.

The sides should be well blistered opposite the region of the liver; and when the bowels are relaxed, the following should be administered every twelve hours:—Opium ½ dr., calomel 1 dr., resin 3 drs., carbonate of

potash 2 drs.; to be made into a ball with soft soap. Vegetable tonics may afterwards be given in combination with the above, or alone, as the symptoms may intimate.

Chronic hepatitis.

Chronic Inflammation of the Liver is attended with symptoms more obscure than those last mentioned, but of the same character, and a dull heavy appearance: the animal should be treated on the same principles, but bleeding must be very moderate, or altogether omitted.

Enlargement of the liver.

Enlargement of the liver is an obscure disease, and creeps on without attracting attention. The symptoms are, enlargement and hardness of the abdomen, bowels either constipated or relaxed, pulse remarkably rapid, and loud and thumping, as in disease of the heart. The *Treatment* should consist of laxatives, calomel and opium, and counter-irritation, and afterwards vegetable tonics; to these the iodide of iron, in doses of a scruple, may be added.

Hepatirrhœa.

Closely connected with this disease is Hepatirrhœa, or rupture of the coats of the liver, and hæmorrhage from it. Old horses are chiefly affected, and the rupture is preceded by structural disorganization, similar to that last described. The *symptoms* vary according to the amount of the rupture and the loss of blood, and whether it be merely effused under the peritoneal coat of the liver, or whether the coat is also broken, and the blood escaped into the abdomen. In the latter case, the loss is considerably greater, and the horse paws, shifts his posture, sighs, curls the upper lip, tosses his head, and exhibits great debility, and partial or total blindness; the pulse is exceedingly quick and feeble, and the membranes blanched. Death occurs in the course of a few hours; and on examining the horse, a considerable quantity of dark blood is found in the abdomen, and various rents in the liver, from which it escaped. This viscus is greatly enlarged, weighing sometimes upwards of sixty pounds; the increased size consisting for the most part of effused and coagulated blood. The structure of the liver is readily broken down, and it is of a fawn or brown colour. If the hæmorrhage is but moderate, or simply under the peritoneal coat, the symptoms are much less urgent, though of the same character, and the horse may rally and apparently recover, only however to sink under the disease at some future time, though perhaps not till after several attacks. The partial or total blindness is a frequent, and sometimes one of the earliest symptoms: the retina becomes gradually insensible to light, and paralysis and amaurosis take place. This may occur first in one eye, and then in the other, and in this case the first attacked, either may or may not be restored to sight. As the animal gets better from an attack, the urine becomes of a dark brown or black colour from the presence of carbonaceous principles, which are thus carried out of the system.

Treatment in this disease can be of little avail; bleeding, however, should be avoided, and preparations of turpentine, copaiba balsam, and alum, may be given; one ounce of the two former, and a drachm of the latter.

Decayed structure of the liver.

Another disease of the liver, and of a very insidious and destructive character, and by no means of uncommon occurrence, may, in the absence of a more appropriate name, be called *Decayed structure.* It often precedes or accompanies other diseases, and greatly increases their danger, sometimes causing blood-letting, or a dose of physic, which would otherwise have been harmless, to produce a fatal effect; and then the liver is found to be of a yellow-brown colour, and sometimes so disorganized as to be easily separated from its covering, and, in fact, a pulpy mass. The *symptoms* are very uncertain and obscure, for the horse may look sleek and fat, although the liver may be dreadfully disorganized. The eyelids and mouth, however, will usually have a yellow appearance; the appetite will be impaired, and faintness and dulness be present. The fæces are usually soft, showing that indigestion exists; and the pulse is as slow, or slower, than usual. Bleeding should be avoided in this disease, and much caution otherwise exercised. Calomel and opium, and aloes, of each one drachm, should be given once a-day in a ball, combined with three drachms of resin. This treatment should be continued for four or five days, and may be followed by mild tonics, regular exercise, and wholesome but not too rich food.

Nephritis.

The *unhealthy* secretions of the liver is sometimes the cause of excessive purging, when the pulse is rapid in the extreme and the debility very great. Such cases should be treated as advised for *super-purgation.*

Inflammation of the Kidneys (*Nephritis*) is not a frequent disease in the horse. The *symptoms* are, considerable pain and distress, very quick pulse, an increased respiration, hot mouth, and other tokens of fever; the horse flinches on the least pressure applied to the loins, and the urine is of a very dark and almost black colour. It may be produced from a strain across the loins, exposure to cold and wet, and too strong or too long-continued diuretics.

Treatment.—Copious blood-letting, repeated if necessary, oily purgatives, stimulating the loins with the iodide of mercury ointment, and applying afterwards a sheep-skin just taken from the sheep's back, the woolly side outwards. The skin should be replaced by another when it begins to smell offensively. Diuretics should be avoided, but sedatives will be very beneficial. A scruple of hellebore twice a-day in a ball, till nausea is produced, has been employed in this disease with much advantage, but requires to be carefully watched. A drachm each of calomel and opium is also very suitable. Injections of warm water should be frequently thrown up, and the diet should consist of mashes and green food.

Injuries of the loins.

Injuries of the Muscles of the loins, from strains or other causes, and giving rise to many of the symptoms above described, although there may not be any actual inflammation of the kidneys themselves, should, however, be treated in the same manner.

Cystitis.

Inflammation of the Bladder (*Cystitis*) is a still rarer disease than that of the kidneys. The symptoms are great pain and fever, with their concomitants and a continued desire to stale. No sooner is urine conveyed to the bladder than it irritates the inflamed mucous coat of this organ, and prompts its immediate and forcible discharge. This disease is more dangerous than that last described.

Treatment.—Extensive bleeding, repeated if demanded. Oily laxatives, sedatives, but no diuretics. Sheep-skin applied to the loins and to the abdomen if possible, or frequent hot fomentations to the latter. Sometimes the neck of the bladder is principally inflamed, in which case the urine is obstinately retained, and in some instances the bladder has been ruptured. This is more likely to occur in the horse than in the mare; whilst the latter is more liable to inflammation of the bladder itself. The treatment should be pretty nearly

Veterinary Art.

alike in both instances; but in the mare we are able to inject mucilaginous liquids into the bladder, whilst in the horse it is scarcely practicable. Linseed tea, made thin, with a few grains of opium dissolved in warm water, should be gently injected into the bladder two or three times a-day; and injections should be thrown up the rectum, which will act in some degree as a fomentation.

Spasm of the neck of the bladder.

Spasm of the neck of the bladder is by no means uncommon, particularly in the horse; it has already been stated that this affection frequently attends spasmodic colic, but then it appears to arise from sympathy, and is removed when the bowels are relieved. The most usual cause is travelling a long distance without being allowed to stale. The urine accumulates in the bladder, and the sphincter muscle which closes its neck having been so long in violent action, it is thrown into a state of spasm and cannot be relaxed. The nature of the disease is shown by the frequent but ineffectual attempts at passing the urine, and the absence of those feverish and other symptoms which denote the accession of inflammation. In the mare relief can at once be attained by passing the catheter into the bladder; but from the difficulty attending this operation in the horse, other means should be previously tried. In the first instance the horse may be bled, then an ounce and a half of tincture of opium and spirit of nitrous ether should be given with a pint of warm water. The bladder should be examined per rectum and the fæces removed at the same time, and gentle pressure used on the bladder, so as to encourage and assist the effort of staling. Clysters of warm water should be thrown up, and if these means fail, we must then have recourse to the elastic catheter, made with twisted wire and caoutchouc. The penis being drawn out at its full length and grasped with the left hand, the catheter, which has been oiled, should be gently forced up the urethra until it passes the angle at the perineum and enters the bladder. The whalebone stilette should then be withdrawn, and the urine will pass through the tube.

Diabetes.

Diabetes, or excessive staling, is generally owing to the disturbance of the digestive organs and foul provender. It is attended with thirst and fever, and is best treated by moderate purging, mineral and vegetable tonics, and iodine.

Urinary calculi.

Urinary Calculus in the horse is more frequently found in the kidneys than in the bladder, and may exist there for years without its being known or suspected. In man, it is generally found in the bladder, which is owing to his erect position favouring the descent of the stone by its gravity. When it occurs in the bladder of the horse, it occasions much uneasiness, and frequent efforts to stale, the act being painful; and sometimes a few drops of blood are passed with the urine. The stone may occasionally be felt, by passing the hand up the rectum, but still better if the animal is thrown and turned on his back.

Lithotomy.

Almost the only method of relief is by the operation of *lithotomy*, which consists in passing a grooved staff up the penis (the horse being cast and turned on his back), until it can be felt at the perineum, where it is cut down upon, and the opening being enlarged by the *bistouri caché*, the forceps is passed into the bladder, and the calculus grasped and removed. Tepid water should be injected into the bladder, so as thoroughly to wash out its contents, and the wound sown up, and the horse released. This operation requires much anatomical knowledge and surgical skill, and though the necessity for it seldom occurs, it has been performed successfully in various instances by the Professors of the Veterinary College and others. The urine will be discharged for some little time through the wound, which will heal gradually, the horse requiring care for several weeks. Calculi have been removed from the mare without this operation, but through the natural opening, by means of the forceps, one hand being kept in the vagina, so as to guide the stone.

Castration.

Castration.—The usual method of performing this operation is to open the scrotum with the knife, put on the clams, and divide the spermatic cord with a hot iron. Another plan is to divide the cord with the knife, tying the vessels, or stopping the bleeding by *torsion.* On the Continent it is customary to place the cord between two elder sticks, tied together, and enclosing a caustic paste, and remove the testicles in a few days. This may be done without cutting into the vaginal sac, but enclosing it with the cord.

Diseases of the brain. Phrenitis.

Diseases of the Brain are far less frequent than those either of the chest or the abdomen, and are comparatively much rarer than in the human subject. Phrenitis, or inflammation of the brain, vulgarly called *mad staggers* is occasionally met with, and is ushered in with symptoms of heaviness, dulness, and unwillingness to move, diminished appetite, and redness of the membrane of the eyelids, &c. These appearances frequently escape observation, which, however, is quickly awakened by those of madness or delirium, which suddenly supervene. The horse plunges about the stall or box with the greatest violence, and will bite his attendants or other horses, rendering it somewhat dangerous to be with him. After exhausting himself by struggling, he will lie or fall down, the violence, however, returning with his strength. The disease consists of inflammation of the brain, and though somewhat resembling rabies, and stomach staggers, may yet be distinguished from them. There is no method in the madness, as in rabies, and with more violence, there is less actual disposition for mischief. In stomach staggers there is generally an inclination to force the head forwards against the rack or other object, and there is a longer duration of the previous stage of dulness than in phrenitis. The cause of this disease may be considered to be too high feeding, and want of sufficient exercise, producing a too great fulness of the vessels or plethora.

The *Treatment* should consist of immediate and profuse bleeding, either from the neck or the temporal arteries, or any large vein that may be more readily opened. The bleeding should continue until the delirium ceases, the pulse falters, or the animal exhibits signs of fainting. More blood can be abstracted in this disease with impunity and advantage than any other, two and three gallons having sometimes been abstracted. Next in importance to bleeding is purging, a strong dose of physic should be given, either in a ball or a draught; the latter is the quickest in its action, but the former is the more certain, and its operation should be assisted by frequent injections. If the animal gets better, the diet should be restricted for some time.

Megrims.

Megrims or *Vertigo* is more frequent than phrenitis; it comes on suddenly, and appears to arise from sudden determination of blood to the head, produced by the pressure of a tight collar, or severe exertion, assisted by the predisposition of the animal, which in some

instances is so great as to render the horse of very little value. The animal will suddenly stop, shake his head violently, reel from one side to the other, and sometimes recover, and at others will fall and struggle for some time with great violence. The *Treatment* consists in immediate bleeding, and giving afterwards a dose of physic.

Rabies. RABIES or *Canine madness* is invariably produced by the bite of a rabid animal, the poison being communicated by the saliva.

The *symptoms* very much resemble those of phrenitis, but with somewhat less violence: there is a greater disposition for mischief. There is not the reckless abandonment of phrenitis; the intellect of the animal is not impaired, but his destructive and combative propensities are more violently excited. One of the most striking symptoms of its approach is a spasmodic movement of the upper lip, and particularly at the angles. Convulsions of different parts of the body succeed, and the horse often fancies he sees some imaginary object at which he will rear. To this succeeds the propensity for mischief, and the state of extreme violence, in which he will often level or destroy all surrounding objects. This generally terminates in paralysis, under which he sinks in the course of three to six days. All treatment after the symptoms have once been developed is fruitless; but if the bitten spot can be discovered, we may succeed in preventing the disease. The writer has operated successfully on various horses that had been bitten by a rabid dog, by carefully applying the nitrate of silver to every part that exhibited the slightest appearance of the bite: if the bitten part can be afterwards conveniently excised, it will render the operation still more secure. The disease is generally developed from six weeks to three months after the bite, and sometimes much longer.

Paralysis. PALSY or *Paralysis* is of two kinds,—*Hemiplegia*, which is paralysis of one side of the body, and *Paraplegia*, which is palsy of the hind extremities. The former is very rarely met with in the horse, the latter is much more frequent, and generally arises from sudden injury of the spinal marrow at the region of the loins, such as a severe fall in hunting, or keeping back a loaded waggon; and it may also be produced by a tumour pressing on the nerves which supply the hind extremities. The former may or may not be accompanied by fracture of the vertebræ, and the latter is generally gradual in its approach. The *treatment* should consist of venesections, laxative and febrifuge medicines, and the application of sheep-skins, and stimulants to the loins. It however frequently happens that although the horse gets better, he is permanently weak in the loins, "chinked in the back" as it is termed, and of no use, except for the lightest work. A disease very similar to this is common in India, and is there called *kumree*.

Kumree.

Tetanus. TETANUS, commonly called locked-jaw, though this is but one of its symptoms, is not uncommon in the horse. It consists of violent spasm of the muscles of the body; if confined to the head and neck, it is called *Trismus*, which is more manageable than when the greater part of the body is convulsed. When it is produced by a local injury, such as a broken knee, a prick from a nail, or docking, or nicking, it is called *Symptomatic*, or *Traumatic;* and when from other causes, such as exposure to wet and cold, or internal disease, it is denominated *Idiopathic*. Spasm of the muscles of the jaw and neck, so that the former becomes nearly or quite closed, is one of the earlier symptoms, from which it gradually extends, till the back and loins become rigid and fixed. The peculiar appearance of a tetanic horse cannot be mistaken—the spine is immoveable, the head poked out, neck stiff, nostrils distended, ears and tail erect, and eyes often distorted; the muscles, thus cramped, feel hard as a board, and the whole aspect of the animal is one of the greatest distress. The nervous system, it is evident, is in a state of the highest excitement; and on the least noise being made, the animal is greatly alarmed, and the respiration much increased and disturbed. The pulse is usually full, and not much quickened. On examining fatal cases, the viscera are often found greatly inflamed and diseased; and the brain and its envelopements, as well as the spinal marrow, frequently exhibit traces of inflammatory action. Various methods of treatment have been recommended and adopted for this severe and fatal disease, and all with occasional success, but more frequent failure.

Idiopathic is more curable than *traumatic* tetanus, and has most frequently yielded to copious bloodlettings, and purgatives, with opium, and camphor, exhibited by the mouth if possible in doses of a drachm each, and also in the form of injections: croton oil forty drops, or aloes, eight drachms of which will not be too strong a dose, as there is much torpor of the bowels. Blistering applications to the abdomen have also proved of much service, and if the disease has arisen from an injury, the cauterization, or removal of the part, or the destruction of its sensibility, by dividing its sensitive nerve, has assisted in the cure.

SPECIFIC DISEASES.—It used to be denied that the horse was subject to rheumatism, but there now can be no question as to the fact, both as regards the acute and chronic kind. The former is commonly termed a *chill*, and arises indeed from exposure to cold, and its reaction. The *symptoms* vary with the muscles that are attacked; if those of the chest, there is very rapid respiration in addition to the other symptoms. In all cases there is great pain, unwillingness to move, considerable fever, the pulse very quick, strong, full, and hard; and the blood, when taken, as we might anticipate from the pulse, is covered with a thick buffy coat, which together with the character of the pulse, is characteristic of the disease. Notwithstanding the great pain and fever, the appetite is but little impaired. The disease is essentially an inflammation of the fibrous tissues, and it may and does fly about from one part to another, but still attacking the same tissue: thus it may affect the fibres of the muscles, the sinews and the ligaments, the bones and their envelopments, and thus it may accompany pleurisy, or precede or succeed it. Rheumatism.

Treatment.—Copious blood-letting and repeated, oily purgatives, diffusible stimulants, diuretics, stimulating liniments rubbed on the affected parts, together with the application of sheep-skins, particularly if the loins are affected. The shoes should be removed from the fore feet, as there is considerable danger of the inflammation flying to the laminæ or *fibrous* tissues of the feet: poultices to the feet will be also calculated to prevent this result. The diet should be light and cooling.

Chronic Rheumatism sometimes occurs as the sequel of the former disease, or independent of it. In the former instance there are frequently bony swellings thrown out about the joints, and the lameness shifts from one limb to another. In the latter instance there is generally lameness flying about from part to part in Chronic Rheumatism.

Veterinary Art.

the most irregular manner, often attacking muscles and sinews, and leaving no external appearance. It is sometimes the result of pleurisy, and the lameness may be either temporary or permanent. The *Treatment* is seldom satisfactory, and must be principally confined to external stimulants, as there are few, if any, constitutional symptoms to combat.

Glanders.

GLANDERS and *Farcy* are two of the most fatal diseases to which the horse is liable; hundreds of animals have been carried off by them, but in consequence of the better stable management and improved ventilation now adopted, these diseases are far less frequent than they formerly were. Glanders is so called from the hard swelling of the submaxillary glands, which is almost invariably found, and is attended with a discharge from the nostrils, somewhat of the nature of pus, which sticks to them, being of a viscid character. This discharge may be either copious or slight, according to the extent of the disease, or the stage it may be in. The disease has been distinguished as Acute Glanders and Chronic. In the former, the discharge is very copious from both nostrils, the glandular swelling is large, and there are frequently ulcers visible on the Schneiderian membrane which lines the nostrils. The pulse is generally slightly increased, and in the advanced stages a snuffling noise is heard when the animal breathes, arising from the obstruction caused by the matter. There is also an unthrifty appearance, hide bound, and deficient condition. In chronic glanders the health is not impaired, or but slightly so; the discharge is generally from one nostril, the left, and the glandular swelling corresponds. No ulcers are visible, and in this state the horse may remain for months, or even years; but at length acute glanders and death succeed. Glanders is undoubtedly a contagious disease. If another horse, or an ass, is inoculated with the nasal discharge, it rarely fails to produce a kindred disease, which, by infecting the whole system, proves fatal in a short time. The inoculated part swells, and the absorbents in the neighbourhood also enlarge, and small abscesses form in their course, thus constituting farcy; but the poison soon reaches the head, and glanders appears. The appearance after death varies with the stage of the disease, for the horse is generally destroyed ere the malady becomes fatal. The membrane lining the nostrils is generally found covered with deep ulcers, which sometimes almost penetrate the thick cartilage called the *septum nasi*, which divides one nostril from the other. This ulceration likewise affects the different sinuses of the head, which are often nearly filled with offensive pus; the turbinated bones are in a carious state, and sometimes the ulceration extends down the windpipe to the lungs, which are occasionally found full of small abscesses and tubercles. In mild chronic cases, the diseased appearances are apparently slight, and confined to a small extent of surface. The causes of glanders are, breathing a confined and unwholesome atmosphere, excessive exertion, bad provender, and contact with a glandered or farcied horse. With regard to the remedy, it must be confessed that, although there are instances of a cure being accomplished, they are so extremely rare that it is only a very valuable animal indeed that will justify the expense of treatment. The sulphate of copper, in large doses, of 4 drs. to an ounce, in a draught, with linseed meal; cantharides 6 to 10 grs., with vegetable tonics, have been found, amongst the host of medicines that have been tried, the most successful in combating this disease, but it too frequently happens, that after a cure has to all appearance been accomplished, the disease again returns with all its former virulence.

Farcy.

FARCY is analogous to glanders, though a different part is affected. It may be produced by glanderous matter, and it may be the cause of glanders. Its usual commencement is generally lameness of one of the legs, usually the hind one, which, on examination, appears to arise from a trifling sore: a swelling takes place which cannot readily be reduced; other sores, or rather small abscesses arise; the absorbent vessels of the limb feel hard and corded, particularly those of the groin. The nature of the disease is now self-evident. It spreads into the system; the fore legs become affected in the same manner as the hind ones; the mischief travels up the neck, attacking the head, and producing glanders and death, if the animal is not previously destroyed.

Treatment.—Although the poison appears to be the same, yet farcy is much more manageable than glanders, although, like it, appearances are very deceptive, and the disease often returns. The abscesses or farcy buds, as they are termed, should be opened as soon as they feel soft, and either the hot iron, or some strong caustic, applied to the ulcer. Iodine should be applied externally in the form of an ointment or liniment, well rubbed into the swollen parts, and particularly in the course of the absorbents. The iodide of mercury ointment will be rather too stimulating, but it may be mixed with the simple iodine ointment, viz., iodine powdered 1 dr., lard 1 oz.; mixed in equal proportions. Internally, the following tonic ball should be given twice a-day:—

Sulphate of iron	2 drs.
Hydriodate of potash	10 grs.
Ginger	1 dr.
Gentian	2 drs.

To be made into a ball with treacle.

The bowels must be regulated by an occasional laxative, and a diuretic ball may be substituted for the above every alternate day. This treatment will in many cases succeed in effecting a cure. The diet should consist of green food or carrots, and about two feeds of corn a-day, and when the horse is convalescent, a month's feed in a good salt-marsh will be beneficial.

Influenza.

INFLUENZA.—The epizootic malady which has received the above designation resembles in many respects the disease of the same name in the human subject. It has not prevailed in this country to any extent since 1840, when its attack was very general, though it is customary with some persons to designate every case of epidemic catarrh as the influenza. This, however, is erroneous; for there are many instances in which catarrh is entirely absent, and therefore we must seek for other invariable characteristics in order to ascertain in what the disease really consists. We always find considerable fever, hot mouth, and quick pulse; the extremities are warm, and, after a few days, swell from serous effusion, which also affects the eyelids to such a degree that temporary blindness is often produced. The pulse is usually soft and weak, and considerable debility is a striking characteristic of the disease. These, therefore, may be regarded as the uniform symptoms of influenza, and in many cases

Veterinary Art.

they are the only ones that are present, and when such is the fact, the disease, if properly treated, passes through its usual stages, and the animal soon becomes convalescent. In the greatest number of cases, however, there is some local inflammation in connection with the general derangement, which may be either trivial or highly dangerous. The nature and seat of this local affection is very much determined by the season of the year: in the summer, affections of the liver and abdominal organs are most frequent, whilst at other periods the respiratory apparatus is most frequently attacked. In fatal cases of the latter description, the ravages of pneumonia and pleurisy are exhibited in the chest, and in the former the liver is found greatly disorganized. Affections of the air-passages are, however, more frequent than derangements of the abdominal organs; and influenza, attended with catarrh and sore throat, constitute the bulk of our cases. In all, however, we may consider the mucous membranes in a state of irritation, so that they are very quickly and severely acted on, either by sympathy or medicinal agents. It is an undecided point as to whether the influenza is infectious, but we incline to the opinion that it is so; although it must be confessed that its appearance, disappearance, and reappearance are often extremely strange and irregular. One of the earliest symptoms is the failure of the appetite, which is attended or immediately succeeded by a dull listless appearance, and the symptoms of fever before noticed; and soon afterwards the soreness of the throat is developed, if the disease takes this form.

Treatment.—If the pulse possesses tolerable strength, we may abstract a moderate portion of blood. The amount, regulated, of course, by the symptoms, in a few instances may be copious, but generally we must be cautious not to abstract too much; from two quarts to four will be usually enough. Though it is desirable to relax the bowels, we must be equally cautious as to this part of our treatment. A pint of linseed oil, or ten drops of croton oil, or half of each combined, may be given with the following diffusible stimulant and febrifuge:—

Spirit of nitrous ether	2 ozs.
Tartarized antimony	1 dr.
Nitrate of potash	4 drs.
Warm watere	½ pint.

Mix.

This may be given twice a-day without the aperient, omitting the nitre after the second day for a day or two, and adding half a drachm of ginger, and one drachm of gentian. It will be rarely prudent to bleed a second time; but if the eyelids are much tumefied, local bleeding from the angular veins, a few inches below the eyes, will be found extremely serviceable; and in many cases, where from the debility of the animal or the lowness of the pulse general depletion will not be judicious, the local bleeding from the angular veins may be adopted with much advantage. If the legs become engorged, they should be bandaged with flannel, and a few punctures with the lancet will afford much relief. The local treatment must be according to the symptoms. If the throat is affected, it should be stimulated externally with a blistering liniment. In severe cases setons will be useful in the region of the throat, and also in the brisket, if the chest appears affected. Blisters on the sides are also in some cases demanded; and if the liver appears to be diseased, we must adopt in some degree the treatment advised under that head. In cases attended with dangerous inflammation of the vital organs, our treatment must be proportionately energetic; but we must still bear in mind that one great peculiarity of the influenza is debility, and as such our treatment must be more moderate with regard to depletion than we should otherwise be disposed to adopt. The diet should consist of bran mashes, green food or carrots, with a moderate portion of corn. A loose box will be useful, and very moderate walking exercise.

Veterinary Art.

Structure of the skin.

Diseases of the Skin.—The skin of the horse, like that of man and other animals, is composed of three distinct coats, the outer of which, termed the *cuticle*, is thin, transparent, and void of vessels and nerves, thus serving as a protection to the vascular parts beneath it. The *cutis*, or true skin, is much thicker, vascular, and extremely sensible, receiving the termination of the sensitive nerves. The hair grows from the cutis, or rather from bulbs planted in it, and pierces the cuticle to appear on its surface. The *rete-mucosum*, or mucous net-work, is situate between the cutis and the cuticle, and secretes a pigment, which gives the colour to the skin, being in some of a dark hue, and in very light-coloured horses absent. When the cuticle is injured or destroyed it is quickly restored, without any perceptible difference; but if the cutis is destroyed, and with it the bulbs of the hair, the latter are not restored, as new skin never possesses hair; this is the reason why horses often become so much blemished from injuries of the knees. The growth of new skin, unlike that of flesh, is extremely tedious, owing to the fact that it grows only from the borders of the old skin, where it first appears as a white line, which gradually widens until the cicatrization is complete.

Surfeit.

The diseases of the skin of the horse are by no means numerous. *Surfeit*, as it is commonly termed, is an inflammatory eruption, arising from plethora or some sudden determination or reaction of the blood on the skin, on which pimples appear: they are sometimes attended with itching. Unless the horse is poor, moderate bleeding and a dose of physic will generally remove the disease; but the alterative powder advised in the next page may also be given. Surfeit will sometimes present an appearance very similar to the mange and in doubtful cases may be treated like it.

Mange.

MANGE is the most contagious disease with which the horse is affected. It is analogous to the itch in the human subject, and, like it, is owing to the presence of very minute insects called *acari*, which are of both sexes, and pierce the skin and multiply in great numbers. The first appearance of mange is accompanied by itching: the horse exhibits pleasure on being rubbed, and on examination we find numerous small pimples on the skin, particularly on the withers and rump; on removing them, a bare spot of a white colour is perceived, from which an ichorous fluid is discharged, which destroys the hair in the neighbourhood. This and the violent itching inducing a horse to rub himself against any object that he can find, causes the hair to come off. Thus it is that horses which have had the disease for some time are nearly bare of hair, and present a loathsome appearance, particularly when the skin becomes wrinkled and thickened, as it does in chronic cases. *Treatment.*—The disease can only be eradicated by topical applications; and of the various medi-

Veterinary Art.

caments that have been employed there is none better than the following:—

Sulphur	4 ozs.
White hellebore	$\frac{1}{2}$ oz.
Oil of tar	3 ozs.
Train, linseed, or olive oil . .	12 ,,

To be carefully rubbed down together and mixed.

This liniment should be well rubbed into every affected part, or, better still, over the whole body, either with the hand, a brush, or a piece of flannel, once a-day for several days, after which the skin should be well washed with soap and water. This treatment may be repeated until the disease is entirely eradicated and the horse no longer rubs himself against other objects, and the following powder should be given daily in the food, or a mash, and continued for seven or eight days:—

Sulphur	4 drs.
Black antimony	2 ,,

Mix, adding occasionally half an ounce of nitre, or giving it in the water.

The mangers, racks, clothes, &c., should be well washed with soap and water, and afterwards with a solution of chloride of lime.

Warts.

Warts are schirrous excrescences, which appear on different parts of the body, and are best removed by the hot iron or the knife. *Wens* are oval or round bodies, found floating loosely under the skin, and they may generally be removed by making an incision through it. An *encysted tumour* is a collection of serous fluid contained in a membranous sac; one part is generally loose and the other attached to the integuments. They are sometimes found at the poll or the withers, and are then generally the result of pressure, and often terminate in fistulous withers or poll evil. These tumours should be carefully dissected out; and in the same manner should those hard, almost cartilaginous, substances which sometimes appear on the shoulders from continued galls. *Melanosis* is a description of tumour, though rare in this country, yet extremely common in India, where it usually affects the tails of white horses. On cutting into the tumours they are found to contain a black fluid. Sometimes they exist within the abdomen, and attached to the spine, where the writer has known them produce gradual paralysis of the hind extremities, by pressing on their nerves and vessels. No cure is known, but iodine may be tried internally and externally.

Encysted tumours.

Melanosis.

The cellular membrane.

The parts immediately beneath the skin principally consist of cellular membrane, which, being elastic, tends to give, with the assistance of the adipose membrane, that softness and resiliency of touch which the horse in good condition exhibits. This membrane is abundantly furnished with a set of vessels called absorbents, which, with the membrane, are the seat of various diseases; the first of these is Anasarca or *Dropsy*, which, in the horse, is of two kinds, one proceeding from debility, and the other from a plethoric or inflammatory state of the system. Horses with round gummy legs having a superabundance of cellular membrane, are most disposed to this disease, which consists of watery swellings generally of the hinder legs. The nature of this enlargement may be readily ascertained by pressing the fingers on it, when the prints of the fingers remain for some little time, showing that it is of a dropsical or watery nature. This disease may be either severe or mild, gradual in its commencement or sudden. Other parts of the body may be affected as well as the legs. The treatment, unless there is great debility, should commence with blood-letting, with a diuretic ball, such as the following:—

Anasarca.

Nitrate of potash	3 drs.
Powdered resin	4 ,,
Oil of juniper	1 scr.
Ginger, powdered	$\frac{1}{2}$ dr.

Soft soap to form a ball;

and, on the following day, a dose of physic. Puncturing the limb, and fomenting afterwards with warm water will relieve the enlargement, with the assistance of hand-rubbing, bandaging, and walking exercise. In some cases it may be necessary to insert rowels or setons in the thigh. If debility supervenes, tonics may be given with diuretics; and if the weakness at first should be so great as to forbid bleeding, the following draught may be administered:—

Nitrate of potash.	1 oz.
Ginger, powdered	2 drs.
Gentian, ,, ...	4 ,,
Sulphate of copper	2 ,,

To be dissolved in a pint and half of warm water, ale, or gruel, then adding 2 ounces of spirit of nitrous ether. To be repeated, if required, on the second day. This disease is commonly termed *humour*, and there is another somewhat resembling it, and requiring the same treatment, which, in Scotland, is termed *Weed*, and commences with a very painful swelling of the absorbent vessels on the inside of the thigh and near the groin, which extends downwards, producing considerable swelling.

Chapped heels.

Chapped Heels sometimes accompanies anasarca, or it may occur without it. It is most frequent in the autumn and in wet weather, and horses with white legs are most disposed to it. A thin acrid discharge appears from the wound, and the irritation causes the horse to catch up the affected leg suddenly and with great force, which greatly retards the healing of the crack. The *Treatment* should resemble that advised for anasarca, to which we may add poultices to the heels for several nights, made with linseed meal and a solution of alum and sulphate of zinc; the cracks may afterwards be dressed with tincture of myrrh or some mild astringent powder.

Grease.

Grease, which consists of an offensive discharge from the heels and legs, often proceeds from the diseases before spoken of being neglected. It should be treated in the same manner as that just recommended, but the local astringents must be longer continued. The following will be an excellent powder to apply to the part:—Prepared chalk, 4 ozs.; sulphate of zinc, 1 oz.; charcoal, 1 oz.; armenian bole, 2 ozs.; and to be finely powdered and mixed.

Structure of the eye.

Local Diseases.—Under this head we must include the *Diseases of the Eye*; but before we do so, it will be desirable to refer to the structure of this delicate and important organ. It consists of various transparent and opaque coats or membranes, forming chambers which contain watery fluids and a surface for the expansion of the optic nerve. If we plunge a needle through the eye, from the front to the back part, it first penetrates the *conjunctiva*, a thin delicate membrane, which lines every part of the eye and its lids that we can see externally; it next passes through the *cornea*, a strong, transparent, double coat, on penetrating which

the needle enters the *aqueous humour*, which consists of two chambers, one in front and one behind the curtain called the *iris*, one edge or border of which is fixed to the eye, whilst the other, the internal, floats loosely in the aqueous humour. This curtain, which in the horse is of a brown colour, has the power of contraction, so as to admit or shut out the rays of light through the oval opening in its centre called the *pupil*, at the upper and lower borders of which we observe some brown or black bodies peculiar to the horse. The needle next enters the *crystalline humour* or *lens*, which is a convex, transparent body, semifluid in its structure. The transparent cornea, rendered convex by the aqueous humour, serves to admit and refract the rays of light, which is still further accomplished by the crystalline lens, the principal glass of the eye. Its posterior part lies in a cavity adapted to it in the *vitreous* or *glassy humour*, which forms three-fourths of the bulk of the eye, and preserves its globular shape. It is composed of watery fluid deposited in cells, and is denser than the aqueous humour, but less so than the crystalline lens. Around the membrane which covers its posterior and lateral surface is spread the *retina* or expansion of the optic nerve, which is of a pulpy nature, a grey colour, and semi-transparent, and on which the picture of external objects is painted in an inverted position, the impression of which is conveyed by the optic nerve to the brain. Behind it there is a dark substance called the *pigmentum nigrum*, which acts like the quicksilver of a looking-glass, preventing the penetration of rays of light and causing the retina to reflect them. Immediately at the back of the eye, this pigment in the horse is of a bluish colour. This *tapetum lucidum*, as it is termed, enables the horse, by reflecting and economizing the light, to see better during the night than would otherwise be the case. The needle next enters the *sclerotic* coat, which is very strong and dense, and surrounds every part of the eye not externally visible. The *optic* nerves cross each other, and then emerge from the cranium at the bottom of the orbit, pierce the sclerotic coat, and are expanded as before stated. The eye is imbedded in fat, which serves as a cushion to prevent injury, and is moved readily on every side by means of muscles, of which there are four straight ones, one above and below, and each side, and two oblique ones, the upper of which acts like a pulley. In addition to these, which correspond to those of man, there is a very powerful strong muscle, called the retractor, immediately at the back of the eye, which draws the eye further within the orbit. These muscles are all attached to the bony orbit and the sclerotic coat, and are furnished with nerves for the communication of motive power, as well as vessels for their nourishment. There is another peculiarity in the horse's eye which requires to be noticed, and that is the elastic cartilaginous substance called *membrana nictitans* or *haw*, the use of which is to act as an additional eyelid in wiping off extraneous particles from the surface of the eye. When the eye is drawn into the orbit by the retractor muscle, the haw is advanced over the eye from its elasticity, assisted by the pressure of the fat in which the eye is imbedded. The anterior portion of the eye is lubricated by the tears which are secreted by the lachrymal gland which is attached to the upper part of the orbit, the superfluous tears being conveyed through a duct to the nostrils. The eyelids are put in motion by distinct muscles.

Diseases of the eye.

The DISEASES OF THE EYE are far less numerous than in the human subject, but are yet so serious that there are probably more blind horses than men in proportion to their relative numbers. *Ophthalmia* is of two kinds, simple and specific; the former, if properly and early attended to, ends in recovery; the latter generally terminates in blindness after a succession of attacks.

Simple ophthalmia.

Simple ophthalmia proceeds from external injury, such as blows, scratches, or hay seed, or other objects getting into the eye. The inflammation is generally considerable, with swelling and closing of the lids, superabundance of tears, and considerable cloudiness of the cornea and aqueous humour; the superficial inflammation is greater, and there is more opacity of the cornea than in—

Specific ophthalmia.

Specific Ophthalmia, which appears to arise from constitutional causes, engendered by stimulating food, hot stables, the escape of ammonia from the urine, and the hereditary predisposition of the animal, derived from its sire or dam. The *symptoms* very much resemble those of simple ophthalmia, but there is less external inflammation and opacity of the cornea, and more derangement in the interior, in the iris, the crystalline lens, and the vitreous humour. In very bad cases all these parts may be simultaneously affected, and blindness may soon follow; but the inflammation is generally more limited, attacking most frequently the crystalline lens and its capsule. When this is the case, the irritation is less than when the iris is principally affected. There is a great impatience of light, and on exposure to it, the pupil is soon closed. After some time the inflammation subsides, even if nothing is done, to be again renewed at another time; and in proportion to the duration, extent, and intensity of the attack is the disorganization that remains. From the periodical character of the disease, it has been absurdly supposed by the ignorant to have some connection with the changes of the moon, and thence it has been termed moon blindness; but though sometimes the attacks may return in about a month, the intervals are generally much longer. It is very important to ascertain, on purchasing a horse, if he has had any attack of ophthalmia; this cannot, however, always be done, for sometimes, with timely treatment, there has been no visible alteration of the structure left. But if we observe any dimness in the aqueous humour, cloudiness in the interior, specks or opacity of the crystalline lens, or unusual smallness of the pupil compared with the other eye, we may justly conclude that the horse has had one or more attacks of specific ophthalmia, which are likely to recur; whereas if there are only streaks across the cornea, or partial opacity of it, and the interior of the eye is bright and healthy, we may conclude that these appearances are to be attributed to simple ophthalmia, which is not likely to return.

The *Treatment* of both diseases should be for the most part the same. If the attack is severe, we should commence by bleeding from the jugular vein on the same side as the affected eye, and follow this on the same or the following day by local bleeding from the angular veins, and lancing the eyelids. A dose of physic should be given, the eye frequently fomented with warm water, and the following lotion afterwards applied:—

Tincture of opium	2 drs.
Extract of belladonna . . .	1 dr.
Water, pure or distilled . . .	1 pint

Mix.

Veterinary Art.

Cataract.

Cataract is the usual sequel of ophthalmia, but sometimes it arises without any previous inflammation; and when small and only semi-opaque, appearing rather to affect the capsule than the body of the lens, it often disappears.

Amaurosis.

Amaurosis, or *Gutta Serena*, is paralysis of the optic nerve, and is attended with partial, or more frequently total, blindness; the eye retaining its brightness, but the iris no longer acting from the stimulus of light. The cure is uncertain and doubtful, but may be attempted by bleeding, purging, and the exhibition of calomel and opium, a drachm of each daily. This disease may arise from blows, injuries of the brain, constitutional derangement, or from causes unknown.

Diseases of the mouth.

Diseases of the Mouth.—*Lampas* is a term commonly given to a swelling of the bars at the upper part of the mouth. It is most common with young horses, and is frequently connected with the process of dentition. Unless it interferes with mastication, it is as well to let it alone; if otherwise, it may be lanced, or removed with a hot iron. It is often accompanied by a swelling of the gums and membrane between the molar and incisor teeth, and which, from getting between the teeth, is more frequently the cause of defective mastication than the lampas. It should be removed by taking it up with a forceps or crook, and cutting off a portion with a pair of scissors or a knife. Sometimes the teeth are found irregular, so as to injure the gums; when this is the case the irregular edges should be removed with a tooth-rasp, made expressly for the purpose. The gums are frequently injured by the bit: when this is the case, the following wash will be found the most suitable:—

Alum	2 drs.
Tincture of myrrh	1 oz.
Honey	1 ,,
Water	2 ozs.

Mix.

Sometimes the bone is greatly injured, and an ulcer is the consequence, the nature of which is ascertained by the very offensive smell that is present. In this case two drachms of hydrochloric acid, mixed with one ounce of tincture of myrrh, should be applied to the ulcer alone on a little tow. This will probably hurry the process of exfoliation, if the injury is sufficient to produce it, and a portion of the bone will be separated from the other part, and may be removed with a forceps; after which, with the application of the lotion, the jaw will soon get well. Other injuries of the mouth and tongue should be treated in a similar manner, viz., by the application of the lotion previously advised.

Injuries of the tongue.

Sometimes the tongue is cut asunder by the halter being placed upon it, the horse's head being then tied up, and the animal in this state hanging back. This injury may also be produced by other means originating in the carelessness or brutality of the attendant. If the tongue is not more than half severed, the divided portions may be united by sutures; but if it is nearly or quite cut asunder, the bleeding vessels should be tied, and the part dressed with the above lotion; and though the horse must be kept on gruel and mashes for some time, it is astonishing how well the mutilated tongue will become adapted to perform its functions, so that corn and hay will be consumed as well as before; but it will not be advisable to turn the horse to grass, as he will not be able to gather the grass either so fast or so well as before.

Obstructions in the œsophagus.

Obstructions in the Œsophagus sometimes arise either from a hard ball getting across, or a piece of carrot or turnip, or other food being hastily swallowed without being properly masticated. If the obstruction lie in the throat, it may often be removed by the hand; but if it cannot be reached, an instrument called a probang, consisting of a long piece of whalebone, with a handle at one end and a ball of wood at the other, should be carefully passed down the œsophagus, so as to force into the stomach the obstructing body. Or if the obstruction is near the throat, it may be withdrawn by means of a suitable probang. If the object cannot be removed by these methods, we must then have recourse to the operation of *œsophagotomy*. The horse's head being elevated, a careful incision must be made through the skin and the coats of the œsophagus, sufficiently large to permit the removal of the obstructing body. The wounds both in the œsophagus and the skin should afterwards be united by separate stitches, and kept clean. No food should be allowed for many hours afterwards; and it should then be given in a soft state.

Structure of the foot.

The Foot of the Horse is an admirable piece of mechanism, but so complicated and minute is its construction that our space will only permit us to mention its various parts, which may be seen in the plates of the horse which accompany the present work; and we must refer the reader who desires more extended information to Spooner's Treatise on the Foot and Leg of the Horse, and other works on the subject. When the foot is on the ground, all that we see externally, is the *wall* or *crust*, which is the strongest part, and bears the weight of the animal. It is attached to the coffin-bone within by means of certain horny leaves or *laminæ*, 500 in number, on its inner surface, which dove-tail with corresponding fleshy plates on the coffin-bone. The lower part of the foot is concave, and is, for the most part, formed by the *sole:* it is incapable of supporting much weight, or pressure, with impunity; thus the shoe is nailed to the crust above, and occasions lameness, if it presses on the sole. The *bars* appear to be inflections of the crust, and meet the frog, which is formed of softer and more elastic horn than the other parts, and acts like a wedge in preventing slipping. The bars and crust are secreted by the laminæ, and the vascular material at the coronet called the *coronary substance;* the sole and frog are secreted by the sensible sole and frog immediately above them, the former being firmly attached to the lower part of the coffin-bone, the latter to the elastic cushion which forms and fills up the back part of the hoof. The coffin-bone, or *os pedis*, corresponds in shape to the hoof which surrounds it, but does not extend so far back, particularly in the middle part: it has cartilages attached to its wings, which extend above the hoof, and sometimes become ossified. At its posterior and central part we find the *navicular* or shuttle-bone, the upper part of which forms, with the coffin-bone in front, and the small pastern above, the coffin-joint, whilst its posterior and lower surface forms the navicular-joint capsule, over which the flexor tendon glides like a pulley just previous to its insertion into the lower part of the coffin-bone. It is this joint capsule which is the seat of the navicular disease, the frequent cause of lameness. The small pastern, or *os coronæ*, is a short, thick, strong bone; above which is

Veterinary Art.

the *os suffraginis*, or large pastern, a longer bone articulating with the metacarpal bone above, and forming the fetlock joint. This important joint is protected on the back by two small bones, the *sesamoids*, which bear a portion of the weight, and are suspended above by the elastic suspensory ligament, thus forming a beautiful spring. The *suspensory* ligament, which becomes double half way down the shank, is attached to the metacarpal bone above, and passes down between this bone and the flexor tendons. The most posterior of these tendons, called the *perforatus*, forms a sheath for the other, the *perforans*, just above the fetlock; which sheath continues half way down the pasterns, where the perforatus is inserted into the small pastern, and the perforans continues on at the back of the navicular bone to be inserted into the lower part of the coffin-bone as before observed. The above brief notice will be better understood by reference to the plates, and our space forbids any further description of these beautiful and complicated organs.

On shoeing.

The Art of Shoeing is extremely ancient, and though not adopted in all countries, it is particularly called for on our hard roads, where the use of the horse would be extremely limited without it. It is a necessary evil, inasmuch as it consists in nailing an inflexible rim of iron to the elastic, though insensible hoof. The subject is one of too great extent to prosecute at any length in our limited space; we must therefore refer to more elaborate treatises, and content ourselves with mentioning certain principles by which it ought to be regulated. It would, however, be folly to attempt to establish any invariable rules, either for the preparation of the foot or the manufacture or putting on of the shoe further than this, that in no case ought the shoe to rest on the sole of the foot, but on the lower edge of the crust alone. The thickness, strength, elasticity, and dryness of the horn vary considerably in different horses; but taking, for example, a foot that possesses an average amount of these qualities, we may observe, that as the shoe prevents the sole and frog from being worn down to the same amount as they grow, as would be at least the case if the foot was unshod, a certain portion requires to be pared with the drawing-knife at each time of shoeing; but in general this paring should be limited to the ragged parts of the frog and the dry portions of the sole. Some of the crust also requires to be lowered, particularly towards the toe and heels; but if the foot is weak and thin, the latter should be held sacred, and the other parts of the foot merely cleaned or scraped out: the sole lying between the crust and the bars at the heels should however be pared out, particularly if there be any disposition to corns. The shoes must be heavy or light in proportion to the size, work, and wear of the horse. It should be made to last, if possible, three weeks; but if not worn out in a month, it ought to be removed, in order that the foot may be properly pared out. The shoe on the fore-foot should generally be of equal thickness throughout, seated on the inner part of the foot surface, and flat on the ground surface, about an inch in width, and one-third of an inch in thickness for saddle horses, and fastened on with eight nails, the back one on the inside being as far removed from the heel as the security of the shoe permits. The hind shoes must be thicker and narrower than the front ones, and rounded off on the inside so as to prevent cutting. The *leather sole* is an excellent addition to the shoe for horses that travel on the road, and in the summer season particularly. It diminishes concussion, protects the horn from too much wear, and preserves the sole soft and elastic by means of the stopping of tar, grease, &c., which is secured by tow between the foot and the leather. There are a variety of shoes adapted to particular feet, and particular circumstances, which cannot well be explained without figures, and can be better understood by visiting the forge of a veterinary surgeon, where may be seen shoes adapted for hunters, others for saddle horses, wider and stouter ones for carriage horses, and heavier shoes still for waggon horses, often turned up at the heels to form calkins for the hinder feet with advantage, but which never ought to be done with the fore shoes. There also may be seen shoes for *cutting*, some thick on the inside, others thicker on the outside, and all *feather-edged*, as it is termed, on the inside. Shoes likewise for corns, with the inner heel made thin, so as not to rest on the ground, and *bar shoes* also for the same purposes. It need not be observed, that the proper shoeing of light horses requires considerable care and skill; and it is a false economy that, to save expense, would be satisfied with inferior workmanship. Two men are usually employed about a horse at the same time—one who fits the shoe, and another who nails it on; the latter perhaps requires to exercise the most care, and the former the greatest skill. Both operations can be much better performed in the forge than the stable, and the feet should invariably be stopped with cow-dung or linseed meal the previous night. This stopping should be used indeed every night in dry weather to the fore feet, and several times a-week otherwise. Dry brittle feet will also be greatly benefited by being occasionally anointed with one part of oil of tar mixed with two or three portions of linseed oil.

On lameness.

Lameness is the natural language of pain, immediately arising from the unequal action of the limb; the horse bearing as lightly as he possibly can on the injured leg. It may exist in every variety, from the severe manifestation of acute pain to the slightest exhibition of partial tenderness. In very acute lameness, most people can point out the suffering limb; but in those of a less severe character, the utmost tact is often required. Persons unaccustomed to horses will more frequently pronounce the wrong limb than the right, in cases of slight lameness. They perceive that a horse drops the moment one foot comes to the ground, and they immediately conclude that that must be the lame one, fancying that he flinches from the pain received when it meets the ground, whereas the fact is, he treads as lightly as he can on the lame foot, and drops with his whole weight on the sound one. In shoulder lameness we can generally ascertain the seat of mischief by the slow and laboured extension of the limb, which is more evident in going down a declivity, and likewise in the walk more than any other pace, the horse having in slow motion more time to move the limb with the care that he wishes. In severe lameness from splints, there is often an unwillingness to bend the knee exhibited; this however is also shown in cases of slight strains of the sinews just under the knee. With these exceptions, the seat of disease, whether of the foot, the pasterns, or the fetlock, cannot be ascertained by the nature of the horse's action.

Mode of detecting the seat of lameness.

In examining a lame horse, it is desirable in the first place to see him undisturbed in the stable, and observe whether he *points* a foot, and in what particular manner he so favours it.

He should then be trotted gently in hand on the hard road or pavement, giving him his head at the time. Having thus ascertained the leg he is lame in, we should proceed to discover the actual seat of the mischief. For this purpose, the finger and thumb should be carefully passed down the leg from the knee to the foot, to ascertain if there is any undue heat, or enlargement, or tenderness from pressure; we should also feel carefully the front and sides of the pasterns, as well as round the coronet. If a splint be the cause of lameness, the horse will evince considerable pain when it is pressed, and so likewise will he in lesions of the sinews. Supposing that we have found no sufficient cause of lameness above, we must now direct our attention to the foot. In nearly every case, unless the mischief should be very clearly exhibited elsewhere, it will be advisable to remove the shoe; the foot should then be pared out to ascertain if there be any wound or bruise in it. The nail-holes and the heels of the sole should be carefully examined and pressed with the pincers, or gently struck with a hammer to discover any symptoms of tenderness. If the horse is very lame from a corn, he will almost always favour the foot, by elevating the heel without extending the foot very far, which will give a knuckling appearance to the limb. Should none of these symptoms be exhibited, we must consider the disease to be deeper seated, and then it is all-important to ascertain if the animal points his foot, for if such be the case, in all probability the cause of lameness exists in the navicular joint.

Lameness connected with shoeing.

Lameness connected with Shoeing.—Horses sometimes exhibit a slight lameness immediately after being shod, though quite sound before. Such cases may arise from the shoe being nailed on too tight, and is often relieved by removing the shoe, and re-applying it more gently. This lameness most frequently occurs in horses with very thin horn, and is ascertained by the manner in which it comes on, and the absence of any other visible causes. The shoe may have an improper bearing, pressing severely on weak parts, or on the sole or heels. *Pricks* most frequently arise from careless or bungling workmanship, the smith not taking proper care, or being deficient in proper skill, or rendered foolhardy by partial drunkenness. Occasionally, however, it will happen with the utmost care, either from unsteadiness of the horse, a particularly thin horn, or perhaps the deceptive appearance of the foot. After a few days, lameness manifests itself, either slight or very severe, and on removing the shoe, and pressing round the foot at the situation of the nails, considerable pain is evinced at the seat of the mischief; and on cutting down on the nail-hole, matter very frequently issues. Sometimes, however, there is no matter formed, but a thin acrid fluid, which denotes that much inflammation still exists in the part, and then the lameness is commonly more severe. In either case it will be desirable to remove the surrounding horn, and immerse the foot in a warm poultice, which should be continued until much of the tenderness is removed, and the parts present a healthy appearance, when the application of a stimulating tar ointment will effect a cure, care being taken that the shoe does not bear too near the injured part.

Sometimes, on removing the shoe, there is no matter found, and indeed no wound, although considerable tenderness. In these cases the nails have been driven too near the quick, although they have not actually penetrated it. The lameness does not come on immediately after the application of the shoe, not indeed until the repeated force of the animal's weight has forced the edge of the coffin-bone so close to the nails as to bruise the sensible parts between these two hard bodies. The best treatment consists in the removal of the shoe and the application of poultices.

Corns

Corns, in most cases, are produced either directly or indirectly by shoeing; directly, when the heel of the shoe actually presses on the heel of the horny sole, and indirectly, when it bears too hard on the crust, or prevents the performance of the functions of the foot. A corn in the horse is a bruise of the sensible sole in the angle between the bar and crust; extravasated blood is thrown out, and this being repeated, at length the vessels of the part, instead of secreting sound horn, deposit a soft spongy material, tinged with blood. Sometimes matter is formed, and at other times we find a black discharge. Corns, though found in all kinds, are most common with flat weak feet having low heels; and they are rarely found in the hind feet or the outside heel. If relief is not afforded, by making an exit below, the matter soon extends upwards and breaks out between hair and hoof, and proves very troublesome. The method of *treatment* for a slight corn consists in cutting away the horn almost to the quick, and applying some caustic, such as the muriate of antimony, to the part. In more severe cases, a poultice should first be applied for several days. A shoe should be put on with the bearing taken away from the affected heel, and the nails removed from the neighbourhood. With flat feet, a bar shoe will best enable the pressure to be removed; with others, a shoe with the ground surface of the affected heel seated off, so that the heel of the shoe does not press on the ground, will best answer the intended purpose. If matter breaks out at the coronet, a large depending opening should be made, the foot well poulticed, and a strong solution of sulphate of zinc injected with a syringe. In some cases the horn should be removed from the coronet to the heel. The treatment here recommended will apply to most other injuries of the feet, such as bruises, wounds from nails, &c.; but if the latter case is severe, blood should be taken from the affected limb.

Quittor.

Quittor is a disease somewhat resembling a festered corn, but it is more deeply seated, having for its locality the lateral cartilages of the foot, in and around which sinuses are formed; and it usually arises from a tread either from the other foot or from another horse. In consequence of the cartilage being injured, the cure is often very tedious, and does not take place till a portion of the cartilage exfoliates. It is expedient to get a good free external opening, and after the foot has been well poulticed, to inject a strong solution of sulphate of zinc. This treatment will often effect a cure, but sometimes it is necessary to insert one or more setons, bringing them out between the bars and the frog. In others a slough may be produced by forcing some oxymuriate of mercury into the sinuses, which will cause a portion of the cartilage to exfoliate; after which the part will heal with ordinary applications. Severe treads should be treated by poulticing and afterwards applying the solution of sulphate of zinc.

Sandcrack.

Sandcrack is a fracture or split in the hoof, which, when it penetrates to the quick, occasions lameness. Its usual seat is the inside quarter of the fore and the front

Veterinary Art.

part of the hind foot. Poultices should be applied for a few days, and as soon as there is sufficient sound horn above the crack, a transverse line should be made with a firing-iron or drawing-knife above the crack, and a strap applied round the hoof, and in time the foot will grow down sound, and the crack disappear.

Thrush. *Thrush* is a common and offensive discharge from the cleft of the frog principally, but sometimes affecting other portions of the frog, which appear, as it were, to be eaten away by the acrid discharge. Though thrush seldom occasions lameness, it renders the frog tender; and when the horse treads on a stone, there is great danger of falling; and if neglected, thrush is apt to degenerate into canker. The ragged parts of the frog should be pared off; and a pledget of tow dipped in the following ointment, and renewed every second day, will usually effect a cure.

Barbadoes tar	4 ozs.
Sulphuric acid	$\frac{1}{2}$ oz.

Mix.

Canker. *Canker* may be produced either by thrush or grease, and sometimes by neglected injuries of the foot. Though it usually commences with the frog, it spreads to the bars, sole, and crust; and when very extensive, it is often incurable. Instead of sound horn, a fungous substance is secreted, together with an offensive discharge, and it is extremely difficult to get the horn to form again, particularly where one part joins another, as between bar and frog. Slight cases may be treated like thrush, but in severe ones the fungus should first be removed by the knife or caustic, and then either the ointment recommended for canker should be applied, or a powder composed of chloride of lime, alum, and prepared chalk. In some cases nitric acid, either alone or with tar, makes the best application. Moderate pressure is extremely desirable, and if the horse can be slightly worked on a dry surface, it will expedite the cure. Moisture must by all means be avoided. If the canker proceeds from injury, and affects the crust, it will be very desirable to remove every portion of the horn that is in the slightest degree connected with the disease. In this way the writer has, after some time, succeeded in curing canker so extensive that one-half of the crust, sole, bars, and frog has been removed and renewed.

Laminitis. *Laminitis* or *Founder* is, as its name implies, an inflammation of the sensible laminæ of the foot, as well as the elastic and very vascular substance that connects with these laminæ the coffin-bone. Horses with weak feet are most disposed to this disease, both in its acute and chronic form. In acute laminitis there is considerable pain and irritation, the pulse strong and quick, the respiration quickened from pain, and the feet hot; the horse is excessively lame, and almost constantly lies down. The last symptom is strongly marked, and serves to distinguish it from other acute diseases. The causes are, long-continued and rapid exertion on the hard roads in hot weather, confinement in a standing posture for a long period, and what is called *Metastasis;* that is, the sudden removal of inflammation from another part; and thus this disease often supervenes on an attack of pleurisy or rheumatism of the chest (a chill). The last cause is perhaps the most frequent and the most likely to be attended with permanent derangement in the structure of the foot. The *treatment* of this disease must be prompt and energetic, and the first thing which demands attention is copious blood-letting. The shoes should be taken off, the soles pared thin, and the circular artery opened by cutting through the horn between the toe and the point of the frog until the blood appears in a free and copious stream and of a red colour. The blood should be abstracted from both feet, if both are affected, and it may be assisted by immersing them in warm water. The bleeding should continue until the system appears to be affected by it: from six to seven quarts will not be too much to abstract. If the horse cannot be readily or freely bled from the feet, the brachial or plate vein at the arm may be selected; but the toe is preferable, being so much nearer the affected parts. After bleeding, the feet should be put in linseed-meal poultices, which should be repeated daily and continued for some time, the feet being also fomented with warm water several times a-day. Unless there is very evident improvement on the second day, bleeding may be repeated, and from the arm. After a few days a blister should be rubbed on the coronet, which should be fomented the following day, so as to remove the effect of the blister, which should be thus repeated several times. Chronic laminitis may be treated in the same manner; the bleeding, however, being practised with less severity. The most favourable termination of laminitis is resolution, in which the inflammation soon subsides, and the parts are restored to their former state. Another result is the separation of the coffin-bone from the crust, the space being filled up with horny substance instead of laminæ, and the sinking of the sole. This is called a pumiced foot, and the horse becomes permanently lame, and fit only for very slow work.

Pumiced feet, however, sometimes arise from weakness of the horn of the foot; and when this is the case, by careful shoeing, so as to protect, and at the same time not to press on the sole, the animal is enabled to do a good deal of work. A blister to the coronet will encourage the growth of horn, and the application of tar to the foot, and a bar shoe, and sometimes a leather sole will be very serviceable. A *seedy toe*, which sometimes accompanies the last-mentioned disease, is a separation of the outer from the inner layer of the crust, which thus appears hollow from the toe almost to the coronet, and at length no longer affords any hold for the nails. The only remedy is blistering the coronet and rest, so as to give time for a new hoof to grow down from the coronet. The disease may be attributed to too great dryness of the foot, want of tone in the secretive parts, and the destructive action of the nails of the shoe.

Strains. *Strain* or *Sprain*, frequently the cause of lameness, is a violent extension of the fibres of a part, causing inflammation either more or less severe, with its attending pain, lameness, swelling, and heat. Strains of the muscles are much less frequent than of the tendons, and, though accompanied with greater pain and lameness, more frequently recover.

Strains of the shoulders. Strains of the muscles of the shoulder sometimes arise from a slip or other extension, and may be distinguished by noticing that the lame leg is not extended so far as the sound one; that the lameness is very evident in the walk, as well as the trot; is greatest on going down hill; and on elevating the leg and pulling it forwards, great tenderness is evinced. *Treatment.*—Bleeding from the arm, fomenting the shoulders, and afterwards applying a liquid blister.

Strain of the flexor sinews. *Strain of the Flexor Sinews* is a frequent case, and is attended with heat, swelling of the part, and pain

Veterinary Art.

Firing.

when pressed. *Treatment.*—Bleeding from the arm, fomentations, and cold lotions to the leg; and when the inflammation is removed, blistering the leg; or if there is evident thickening, what is still better, *Firing.** In severe cases a patten shoe, so as to elevate the heel of the affected leg and put the tendons in a state of rest, will be found useful. The following lotion will be the most effectual:—

Sal ammoniac	1 oz.
Arabic acid	2 ozs.
Spirits of wine	1 oz.
Cold water	20 ozs.

Mix.

Strain of the suspensory ligament.

Strain of the Suspensory ligament is nearly as common as that of the tendons; the lameness, though less severe, is often more obstinate. The part is hot, swollen, and tender on pressure. The treatment should be the same as that just advised, and the firing is particularly required; and, if performed, by making punctures so as to penetrate the skin, it will be more effectual. Strains of the ligaments of the fetlock joint should be treated in a similar manner; and so likewise with regard to the pastern joint, which is often the forerunner of ringbones. *Strains* of the ligaments of the *coffin-joint* are rare, the joint being so securely situated. When occurring, however, bleeding from the foot, poulticing, and blistering the coronet will be the proper treatment.

The navicular disease.

The *Navicular disease* is one of the most frequent lamenesses with which the horse is affected. It consists of inflammation and ulceration of the navicular joint capsule. The navicular bone is generally denuded of cartilage, with small bony excrescences, and sometimes ulcerated holes on its posterior surface, and occasionally adheres to the sinew. The symptoms of this disease are, lameness, greatest at first and diminishing with exercise; the absence of all cause of lameness elsewhere; contraction of the foot; thickening and elevation of the sole, and pointing; that is, the foot is put out several feet beyond the other, and bears no weight: the foot and coronet rarely feel hot, unless the lameness is sudden and very severe. Confinement in the stable, hot litter, shoeing, and particularly the hard roads, may be considered as the causes of this disease. It is very frequently incurable, ulceration having commenced; but the following *treatment* may be tried, which has occasionally proved successful. The sole should be pared thin, the quarters well rasped, the feet bled and poulticed; and then the coronets blistered, or a seton inserted through the heel and the cleft of the frog, and kept in for a month. If this treatment should fail, and the horse is too lame to be useful, the only resource left is—

Neurotomy.

Neurotomy, or the nerve operation. The horse having been cast or thrown by means of the hobbles, the foot to be operated on should be liberated, and drawn out straight, and an incision made through the skin a few inches above the fetlock, and between the flexor sinews and the suspensory ligament. In this space the nerve will be found, on removing some of the cellular membrane, somewhat behind the artery on the inside, and posterior to the vein on the outside of the leg. A little thread should be carried under the nerve, which should be drawn up, and divided at the upper part of the incision, and an inch and a half of it excised. The horse is then to be turned, and the operation repeated on the other side of the leg. The leg should be previously rendered perfectly cool, by immersing it in a bucket of cold water for half an hour at a time, so as to prevent bleeding from the small vessels, which would render the operation difficult and tedious. The object and immediate effect of the operation is to remove pain, and consequently lameness, by cutting off sensation between the diseased part and the brain. There being no muscles below the knee, the nerves only communicate feeling, and by dividing them, pain is of course removed with sensation, and by removing a portion of some extent the reunion of the nerves is prevented. The operation has succeeded in very many instances, and the horses have worked for some years afterwards. It is generally performed above, but sometimes on or below, the fetlock; the effect of the latter mode is to afford some degree of feeling to the foot, as the branches that supply the coronet are given off above the seat of the operation. The wounds after the operation should be bandaged, and treated as an ordinary wound. The horse should not be turned to grass, but may be put to moderate work, in the course of six weeks or two months after the operation. It is evident that the effect of the operation is to remove the lameness, but not the disease which produces it; this should be borne in mind, and the horse should be employed afterwards in moderate work alone. When this is not observed, and the horse is hunted or otherwise worked violently, or allowed to gallop at grass, the diseased sinew, which the disease had rendered thinner, and fixed to the bone, sometimes snaps asunder, the toe of the foot turns up, and the horse is rendered useless. In proper cases, it is a valuable and humane operation, and reflects great credit on Professor Sewell, by whom it was introduced.

Exostosis.

Exostosis is a diseased enlargement of bone, from an increased action of the vessels by which it is nourished, and usually arises from inflammation produced by strain or concussion: horses are very subject to this disease, which under the terms splint, ringbone, spavin, &c., are frequently the cause of lameness.

Splint.

Splint or *Splent*—is a bony deposit, situated between the large and small metacarpal bones, generally on the inside of the leg, and a few inches from the knee. Most horses are subject to it when about four or five years old, and in the majority of instances it is not attended with lameness. In some instances, however, there is severe, and in others slight lameness, which appears to arise from the state of tension in which the periosteum, or membrane covering the bone, is placed, by the increased deposition beneath it. In those cases, unattended with lameness, the growth of bone is so gradu-

* The operation of Firing, though severe, is often necessary, and succeeds in many cases in which milder methods have failed. It should not, however, be practised when less severe remedies will succeed. The method of performing it is simple, though requiring some tact and care. The horse having been cast, the leg to be operated on must be sufficiently liberated to expose properly the affected part, on which lines about half an inch apart should be drawn by means of irons, with a moderately sharp edge, and heated to a red heat. An oblique direction is the most convenient, and the degree of heat to be applied must depend on the thickness of the skin and the nature of the case. In general it should not penetrate the cutis, but should be continued until the line it causes is of a brown colour. Its action may be increased if necessary by making punctures through the skin with a pointed iron; and in some cases the firing may be limited to these punctures with advantage, as producing a deep-seated effect with little blemish.

that its covering has time to accommodate itself to the increased size. When lameness proceeds from splents, pressing them occasions considerable pain. *Treatment.*—In very slight cases a little blistering application on the seat of the splent will be sufficient, but in severe cases, the best mode of treatment consists in the operation of *periosteotomy*. The horse must be cast, and an incision made at the lower part of the splent, one-third of an inch in length, and a small narrow knife, blunt pointed—made for the purpose—must then be passed up under the skin, the whole length of the splent, and the periosteum must be divided by pressing it up and down. A small opening being made above, a seton may be inserted and kept in for a fortnight. The effect of the operation is to remove the tension of the periosteum, which puts a stop to the inflammatory action and the lameness.

Periosteotomy.

Spavin.

Spavin is a much more serious evil than a splent: it is perhaps in nine cases out of ten attended with lameness, which in the majority of instances is incurable. Its situation is the inside of the hock, on the small bones of the joint, which are frequently anchylosed, or connected together permanently by a bony substance, and the synovial membrane and cartilage are often in a state of ulceration. This state of the joint sometimes exists either in the upper or one of the lower articulations of the hock, and then the lameness is very obscure, and often incurable. *Treatment.*—If there is heat perceptible in the hock, blood should be taken from the saphena vein, which passes up on the inside of the thigh, and the inflammation reduced by cooling lotions; after which the part should be repeatedly blistered with the iodide of mercury ointment, mixed with the common blister; or the horse may be fired. Some incurable cases have been relieved by excising the nerves above, and on the inside of the hock.

Wind-galls are soft swellings existing near the fetlock joints, either formed by the distension of the capsular ligament, or the sheaths of the tendons with synovial fluid; sometimes there is a rupture of the connections of the sheath, and a consequent enlargement of the cavity. They rarely occasion lameness.

Bog-Spavin and *Thorough-Pin* are similar in their nature to wind-galls. The former is found at the lower and anterior part of the hock-joint, and the latter at the upper and back part of the same cavity. The best treatment of these enlargements is the application of the iodide of mercury ointment, which should be well rubbed into the part, and renewed once a-week, washing off the effects of the previous application in the interval.

Ringbones.

Ringbones are bony formations on the pasterns, arising from strains of the ligaments or concussion. The seat of disease may be detected by the enlargement, which is generally attended with heat. The *treatment* should be the same as that recommended for spavins, and is generally attended with greater success.

False ringbones.

False Ringbones are ossification of the side cartilages of the foot, and usually proceed from concussion. Heavy draught horses are most liable to this disease, which is not so usually attended with lameness as the true ringbone, to which the treatment should be similar. This disease sometimes accompanies that of the navicular joint. When the usual treatment fails, the nerve operation should be employed. Exostosis sometimes occurs round the fetlock and other joints, and should be treated as before advised.

Fractures.

Fractures are not so common in the horse as in the human subject, and are generally treated with less success. This arises from the great displacement of the bones from walking on them after the fracture, the difficulty in keeping the horse in a quiet state, the want of the recumbent posture, and the displacement of the bones from muscular action. Fractures of the upper parts of the limbs are therefore scarcely ever attended with success, and the most prudent plan in such cases will generally be to destroy the horse. Fractures of the bones below the knee are, however, not unfrequently cured; very much depends on the disposition of the animal, whether he is quiet, or irritable and fractious; in the latter instance, the chance of cure is but slight; and it must be confessed, that in successful cases, much more depends on nature than on surgical skill. The parts being carefully bandaged, and kept wet and cool, will in many cases be as successful as more laboured treatment.

Dislocations.

Dislocations are, from the little lateral motion the joints possess in the horse, still rarer than fractures: they can scarcely occur without a rupture of the ligaments. Dislocation of the patella or knee-pan, which is situated at the stifle-joint, sometimes occurs, and mostly in young animals, and arises either from sudden and violent exertion, or from relaxation of the ligaments; when it takes place the animal is in much pain, cannot flex his hind leg, but drags it after him. The disease is often mistaken for cramp and other diseases. Sometimes, on alarming the horse, the patella will slip suddenly into its place; at others, this cannot be done without assistance. The foot should be drawn forwards with some force, and the bone pressed into its place, while the limb is thus extended; after which a blister should be applied over the part, and the animal kept perfectly still. Dislocation of the neck sometimes occurs from the horse being cast in his stall: the writer has had several cases in which he has succeeded in establishing a cure, by suspending the head, bandaging, splints, and anti-phlogistic treatment.

Dislocation of the patella.

Wounds.

Wounds.—The healing process in the horse is generally carried on with rapidity and vigour, particularly if the injury is confined to the muscles or flesh. A simple incised wound may be sewed up, but in a lacerated wound it is vain to attempt this method. Warm fomentations and cold lotions should be employed to abate the inflammation, and the wound may afterwards be dressed with tincture of myrrh or aloes, which will assist the healing process; or powdered resin may be scattered over the wound at first, and powdered chalk, alum, and Armenian bole afterwards. Bandages in some cases will be useful, in others not desirable. If matter forms, it will be essential that it should have a depending opening, which should be made and preserved by a seton. A wound of a joint, as the knee or fetlock, is entirely a different affair; the grand thing is to close the joint as quickly as possible before inflammation is set up in the cavity, which will quickly take place, unless the synovia or joint-oil is prevented from escaping, and the air from entering the joint. Poultices and fomentations on the wound are exceedingly injurious. If the opening is small, a hot pointed iron will often close the joint, or a paste of linseed-meal may be applied to the wound, and retained firmly by numerous bandages; this will generally be the most efficient method, and the inflammation, may then be kept down by local bleeding and fomentations without removing the bandages, which should be retained for some time.

Veterinary Art.

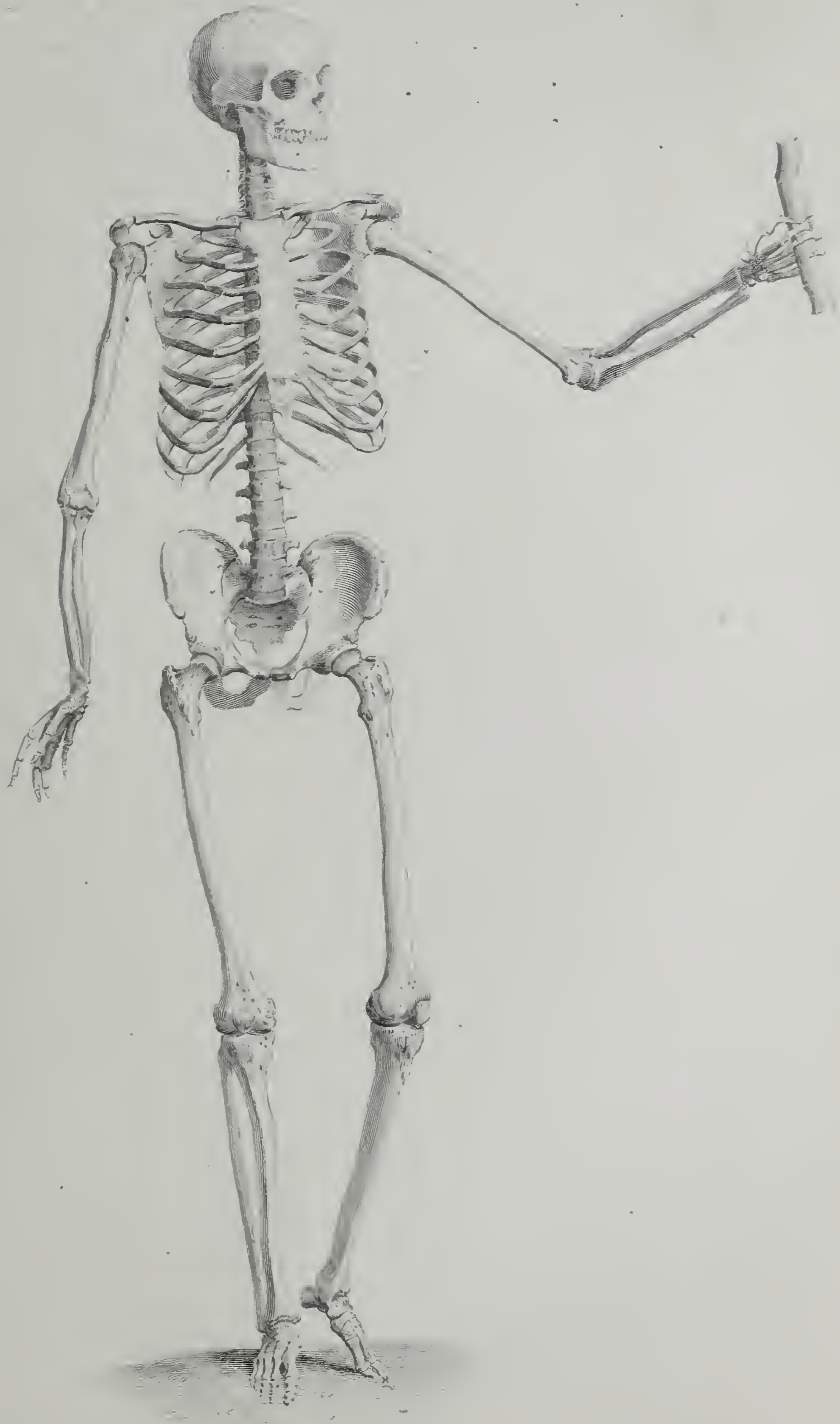
A saturated solution of bichloride of mercury, in spirits of wine, and applied to the wound by means of a feather several times a-day, has in many instances proved successful, and the following powder is also much to be recommended :—Burnt alum, myrrh, and sulphate of iron, equal parts, to be frequently applied to the wound. When the synovia has ceased to run, the injury may be treated as a common wound.

For a more extended acquaintance with the subject of this article, we must refer to the works of our Veterinary Authors, amongst whom we may mention as the principal, the names of Coleman, Clark, Bracy Clark, Blaine, Darville, John Field, Goodwin, Morton, Percival, W. C. Spooner, Stewart, James Turner, and Youatt.

END OF VOL. VII.

LONDON: PRINTED BY WM. CLOWES AND SONS, STAMFORD-STREET.

Front View of the Male Skeleton.

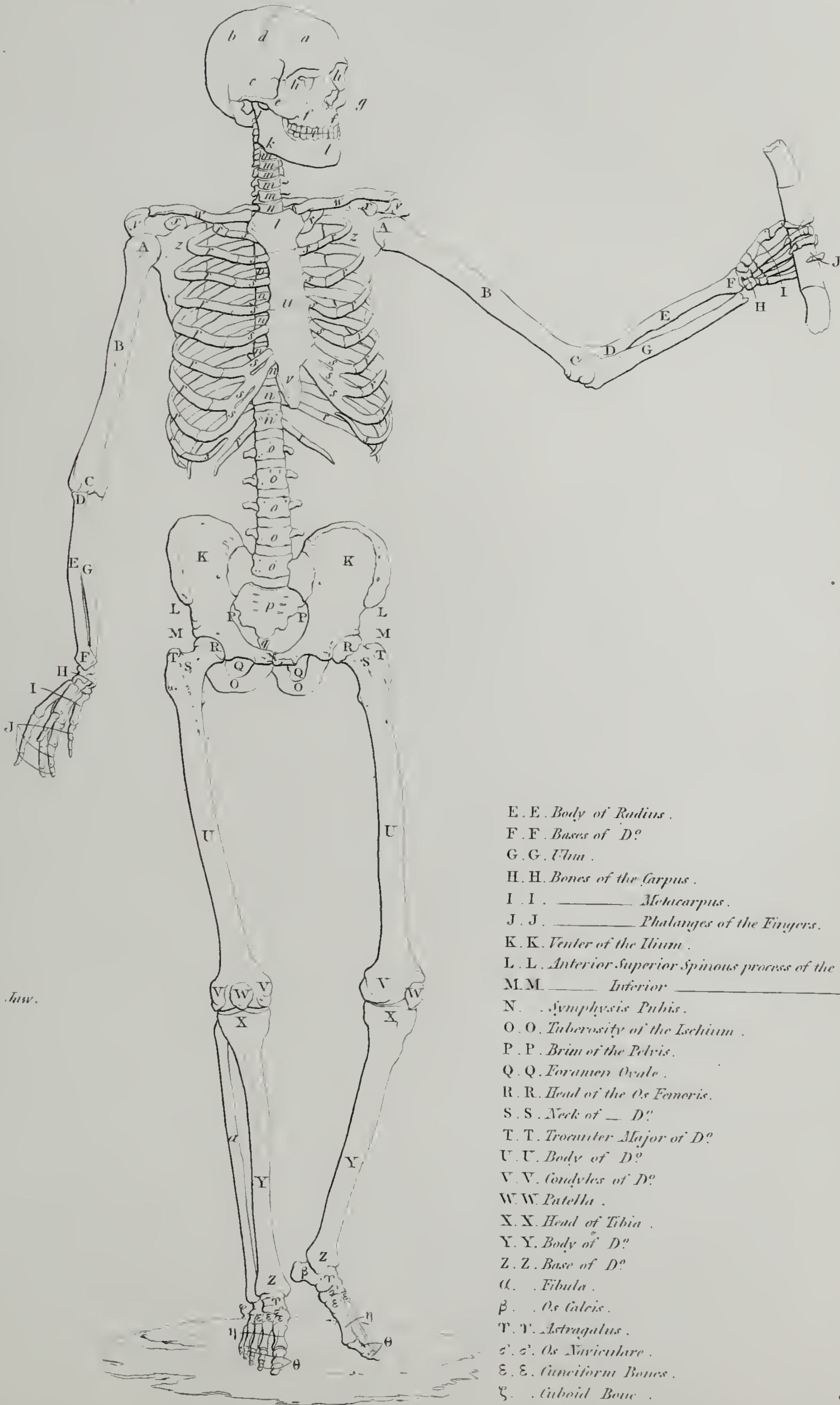


APOLLO BELVIDERE

Published as the Act directs Jan. 1 [illegible] by J. Mawman London

ANATOMY.

Reference to the Front View of the Male Skeleton.



a . *Os Frontis.*
b . *Parietal Bone.*
c . *Temporal Bone.*
d . *Coronal Suture.*
e . *Os Malae.*
f . f . *Superior Maxillary Bone.*
g . g . *Ossa Nasi.*
h . h . *Orbits.*
i . *Teeth.*
j . *Condyloid process of the lower Jaw.*
k . *Angle of Do.*
l . *Symphysis of Do.*
m. m. *Cervical Vertebrae.*
n . n . *Dorsal _ Do.*
o . o . *Lumbar _ Do.*
p . *Os Sacrum.*
q . *Os Coccygis.*
r r . *Ribs.*
s . s . *Cartilages of the Ribs.*
t . *First bone of the Sternum.*
u . *Second bone of Do.*
v . *Cartilago Ensiformis.*
w . w . *Clavicles.*
x x . *Coracoid process of Scapula.*
y y . *Acromion of Scapula.*
z z . *Venter of Do.*
A A . *Head of the Os Humeri.*
B B *Body of Do.*
C C . *Condyles of Do.*
D D . *Head of Radius.*

E . E . *Body of Radius.*
F . F . *Bases of Do.*
G . G . *Ulna.*
H . H . *Bones of the Carpus.*
I . I . ________ *Metacarpus.*
J . J . ________ *Phalanges of the Fingers.*
K . K . *Venter of the Ilium.*
L . L . *Anterior Superior Spinous process of the Ilium.*
M.M. _____ *Inferior* ________________ *Do.*
N . *Symphysis Pubis.*
O . O . *Tuberosity of the Ischium.*
P . P . *Brim of the Pelvis.*
Q . Q . *Foramen Ovale.*
R . R . *Head of the Os Femoris.*
S . S . *Neck of _ Do.*
T . T . *Trocanter Major of Do.*
U . U . *Body of Do.*
V . V . *Condyles of Do.*
W. W. *Patella.*
X . X . *Head of Tibia.*
Y . Y . *Body of Do.*
Z . Z . *Base of Do.*
α . *Fibula.*
β . *Os Calcis.*
γ . γ . *Astragalus.*
δ . δ . *Os Naviculare.*
ε . ε . *Cuneiform Bones.*
ζ . *Cuboid Bone.*
η . *Metatarsal Bones.*
θ . *Phalanges of the Toes.*

Published as the Act directs, April 1.1824, by J. Mawman, Ludgate Str.t

Lowry, sc

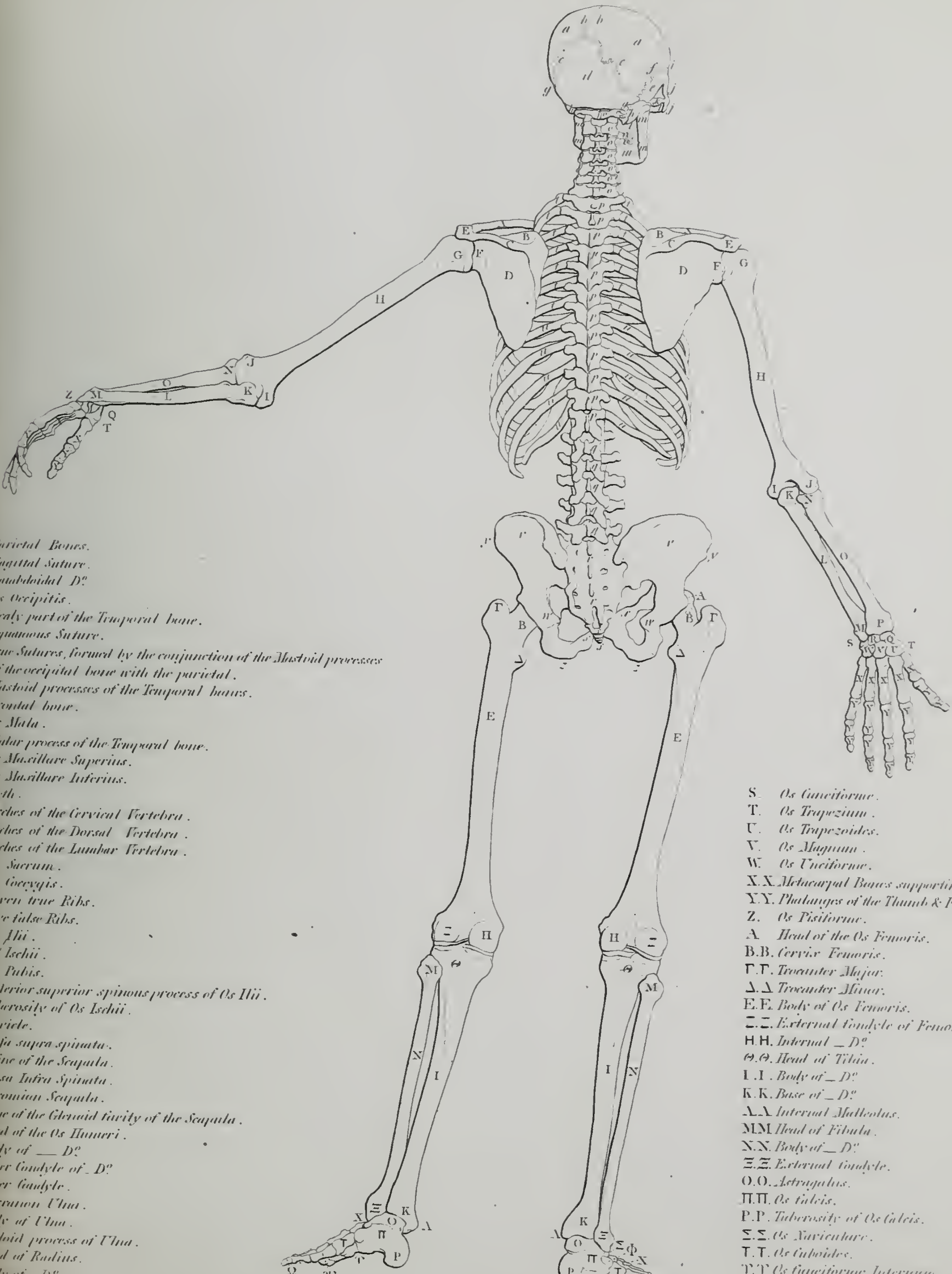
ANATOMY.

Back View of the Male Skeleton.

Published as the Act directs, Jan^y 1. 1824, by J. Mawman, Ludgate Street.

ANATOMY.

Reference to the Back View of the Male Skeleton.



a.a *Parietal Bones.*
b.b *Sagittal Suture.*
c.c *Lambdoidal D°.*
d *Os Occipitis.*
e *Scaly part of the Temporal bone.*
f *Squamous Suture.*
g.g *True Sutures, formed by the conjunction of the Mastoid processes of the occipital bone with the parietal.*
h.h *Mastoid processes of the Temporal bones.*
i *Frontal bone.*
j.j. *Os Mala.*
k *Malar process of the Temporal bone.*
l.l *Os Maxillare Superius.*
m.m. *Os Maxillare Inferius.*
n.n. *Teeth.*
o.o. *Arches of the Cervical Vertebra.*
p.p. *Arches of the Dorsal Vertebra.*
q.q. *Arches of the Lumbar Vertebra.*
r.r. *Os Sacrum.*
s.s. *Os Coccygis.*
t.t. *Seven true Ribs.*
u.u. *Five false Ribs.*
v.v. *Os Ilii.*
w.w. *Os Ischii.*
x.x *Os Pubis.*
y.y *Anterior superior spinous process of Os Ilii.*
z.z *Tuberosity of Os Ischii.*
A.A. *Clavicle.*
B.B. *Fossa supra spinata.*
C.C *Spine of the Scapula.*
D.D *Fossa Infra Spinata.*
E.E *Acromian Scapula.*
F.F *Edge of the Glenoid Cavity of the Scapula.*
G.G. *Head of the Os Humeri.*
H.H. *Body of* ___ *D°.*
I.I *Inner Condyle of* _ *D°.*
J.J. *Outer Condyle.*
K.K. *Olecranon Ulna.*
L.L *Body of Ulna.*
M.M *Styloid process of Ulna.*
N.N *Head of Radius.*
O.O *Body of* _ *D°.*
P *Base of* _ *D°.*
Q.Q *Os Scaphoides*
R *Os Lunare*

S. *Os Cuneiforme.*
T. *Os Trapezium.*
U. *Os Trapezoides.*
V. *Os Magnum.*
W. *Os Unciforme.*
X.X. *Metacarpal Bones supporting the Thumb & Fingers.*
Y.Y. *Phalanges of the Thumb & Fingers.*
Z. *Os Pisiforme.*
A. *Head of the Os Femoris.*
B.B. *Cervix Femoris.*
Γ.Γ. *Trocanter Major.*
Δ.Δ. *Trocanter Minor.*
E.E. *Body of Os Femoris.*
Ξ.Ξ. *External Condyle of Femoris.*
H.H. *Internal* _ *D°.*
Θ.Θ. *Head of Tibia.*
I.I. *Body of* _ *D°.*
K.K. *Base of* _ *D°.*
Λ.Λ *Internal Malleolus.*
M.M *Head of Fibula.*
N.N. *Body of* _ *D°.*
Ξ.Ξ. *External Condyle.*
O.O. *Astragalus.*
Π.Π. *Os Calcis.*
P.P. *Tuberosity of Os Calcis.*
Σ.Σ. *Os Naviculare.*
T.T. *Os Cuboides.*
Υ.Υ *Os Cuneiforme Internum.*
Φ.Φ. ——— *Medium.*
Χ.Χ ——— *Externum*
Ψ.Ψ. *Metatarsal Bones, suppor…*
Ω.Ω. *Phalanges of the Toes.*

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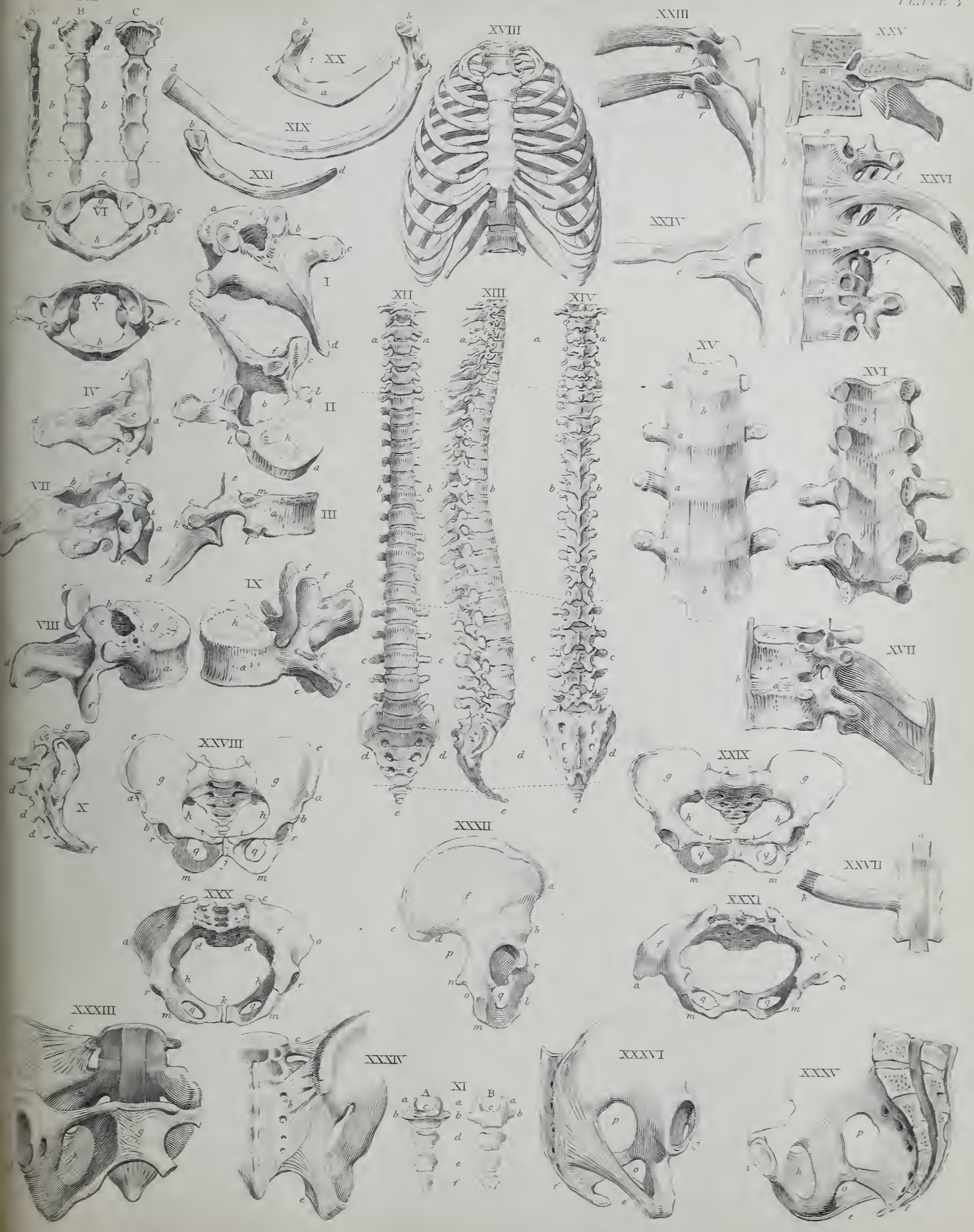
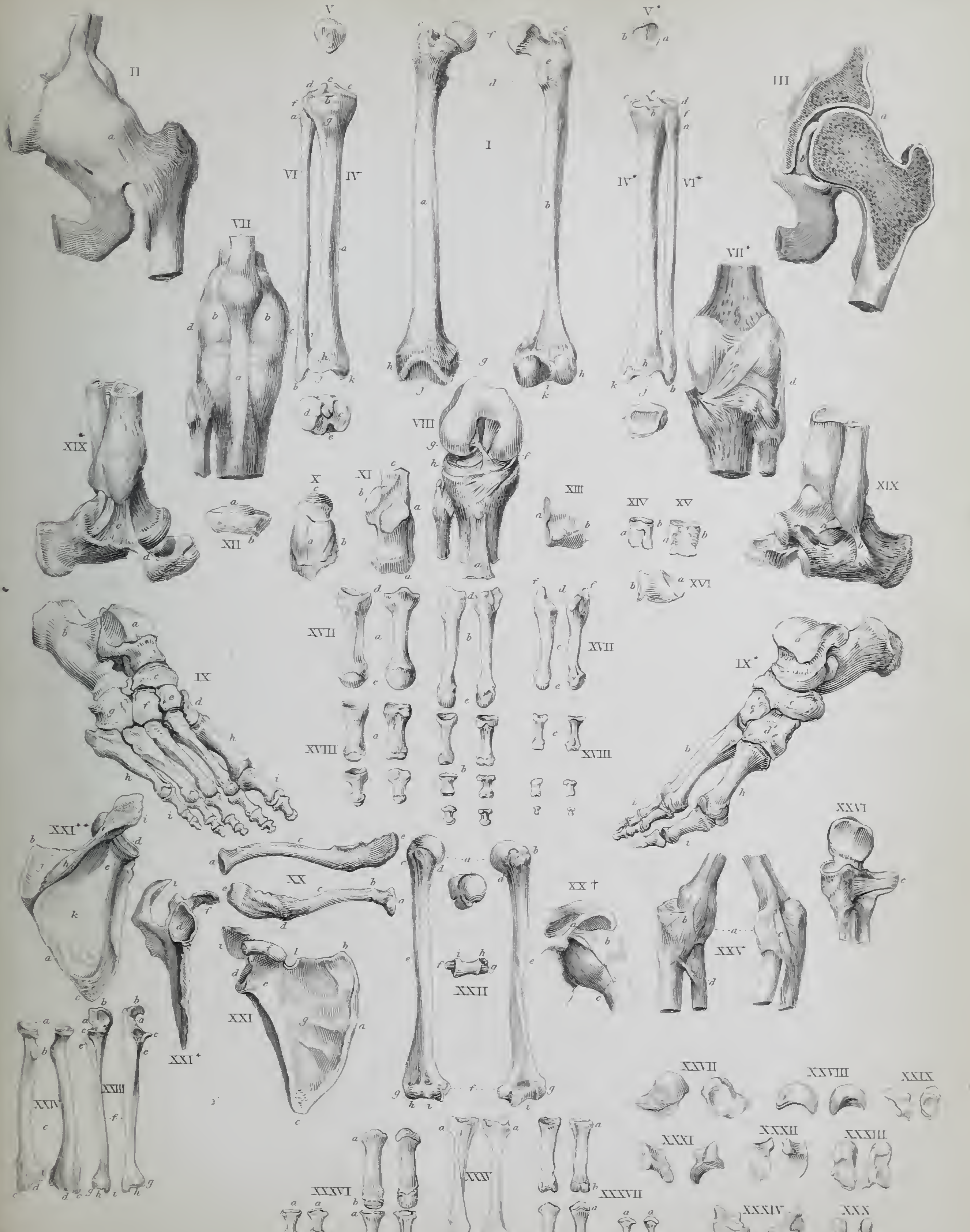
ANATOMY.



W.H. Kearney, Delin.

Published July 1839, by B. Fellowes, 39, Ludgate Street

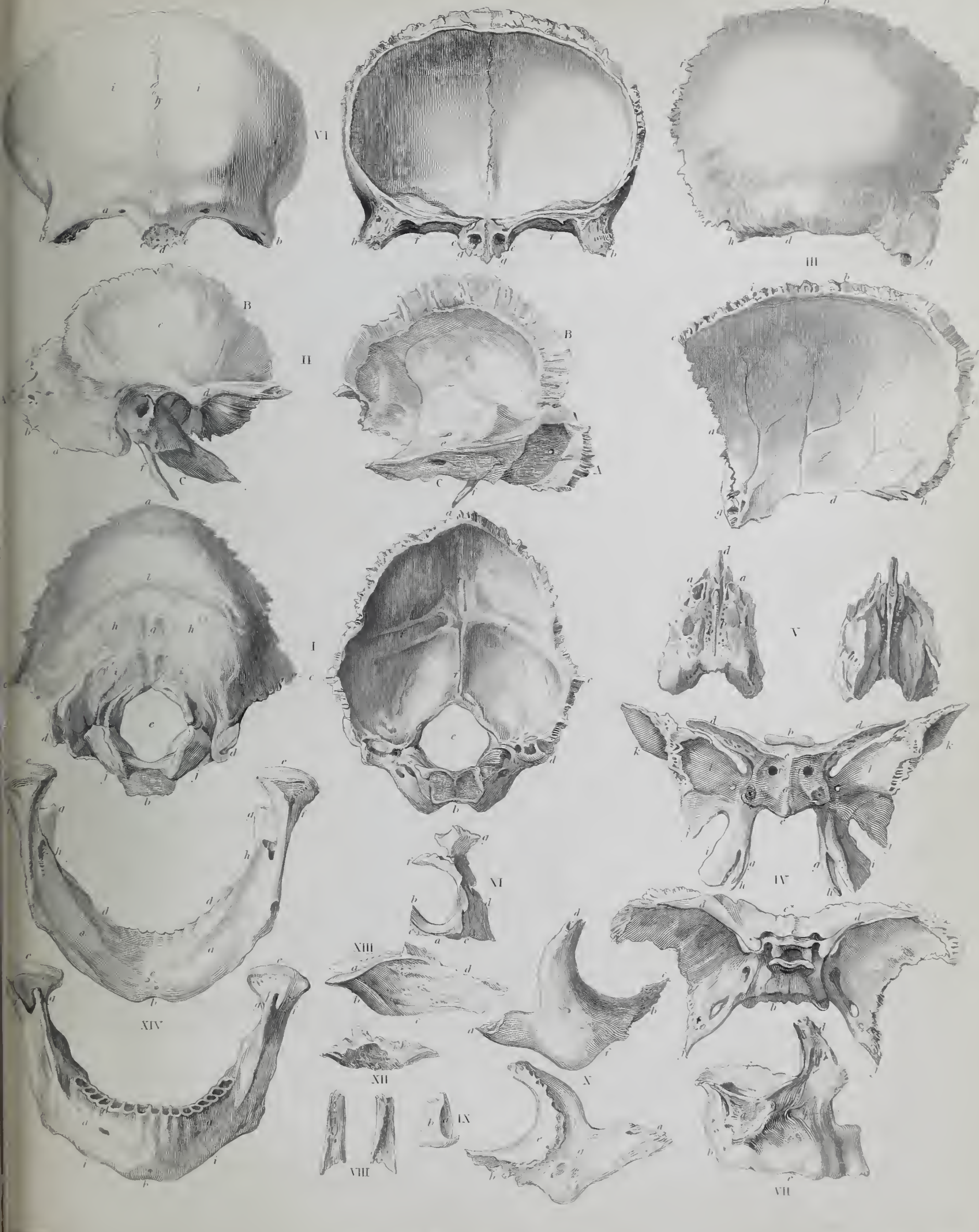
J.W. Lowry, Sculp.



Kearney Delin

J.W.Lowry sculp

Published July 1839 by E Fellowes 39 Ludgate Street



delin

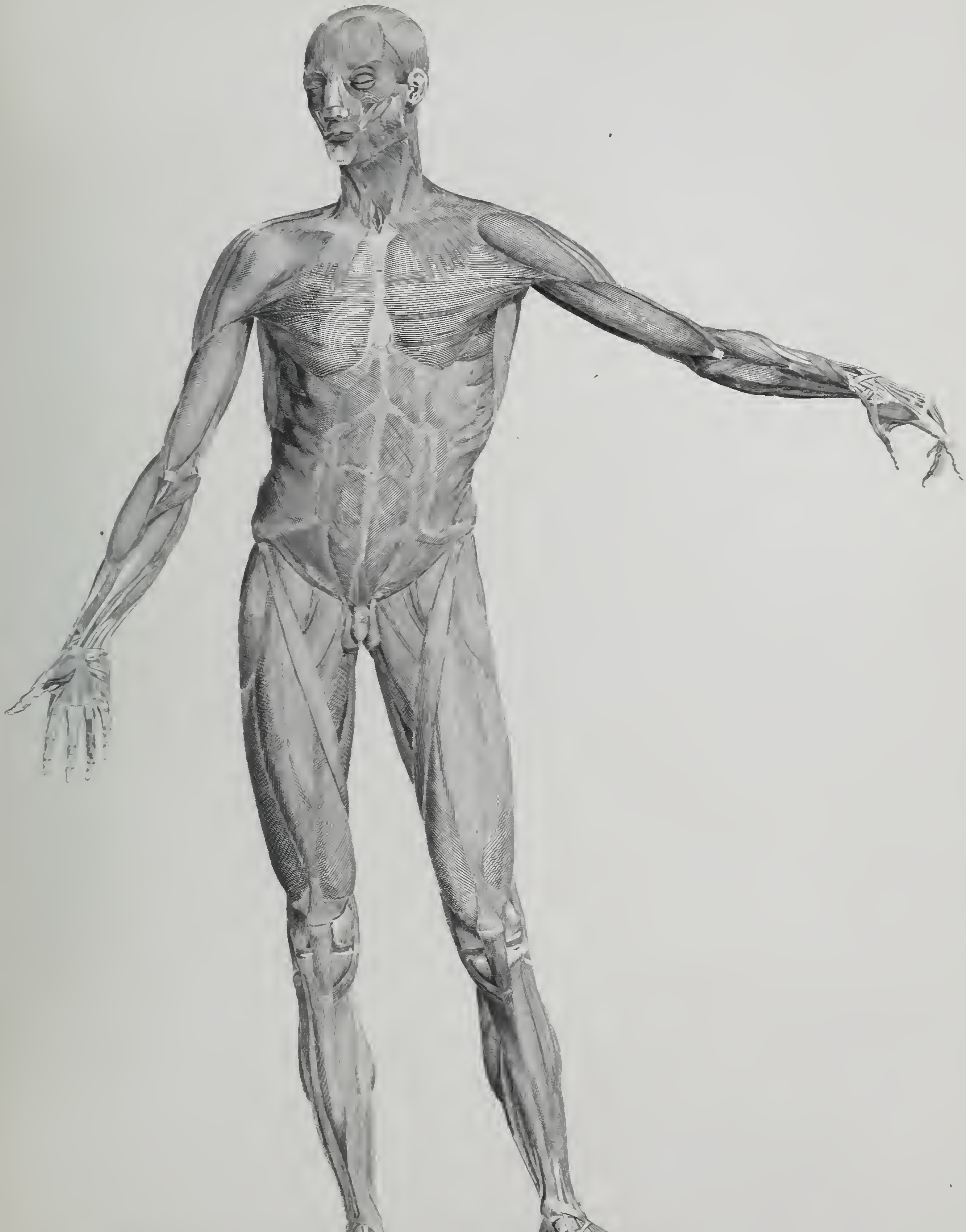
Published March 1st ... by B. Fellowes 35 Ludgate Street

J.W. Lowry

ANATOMY.

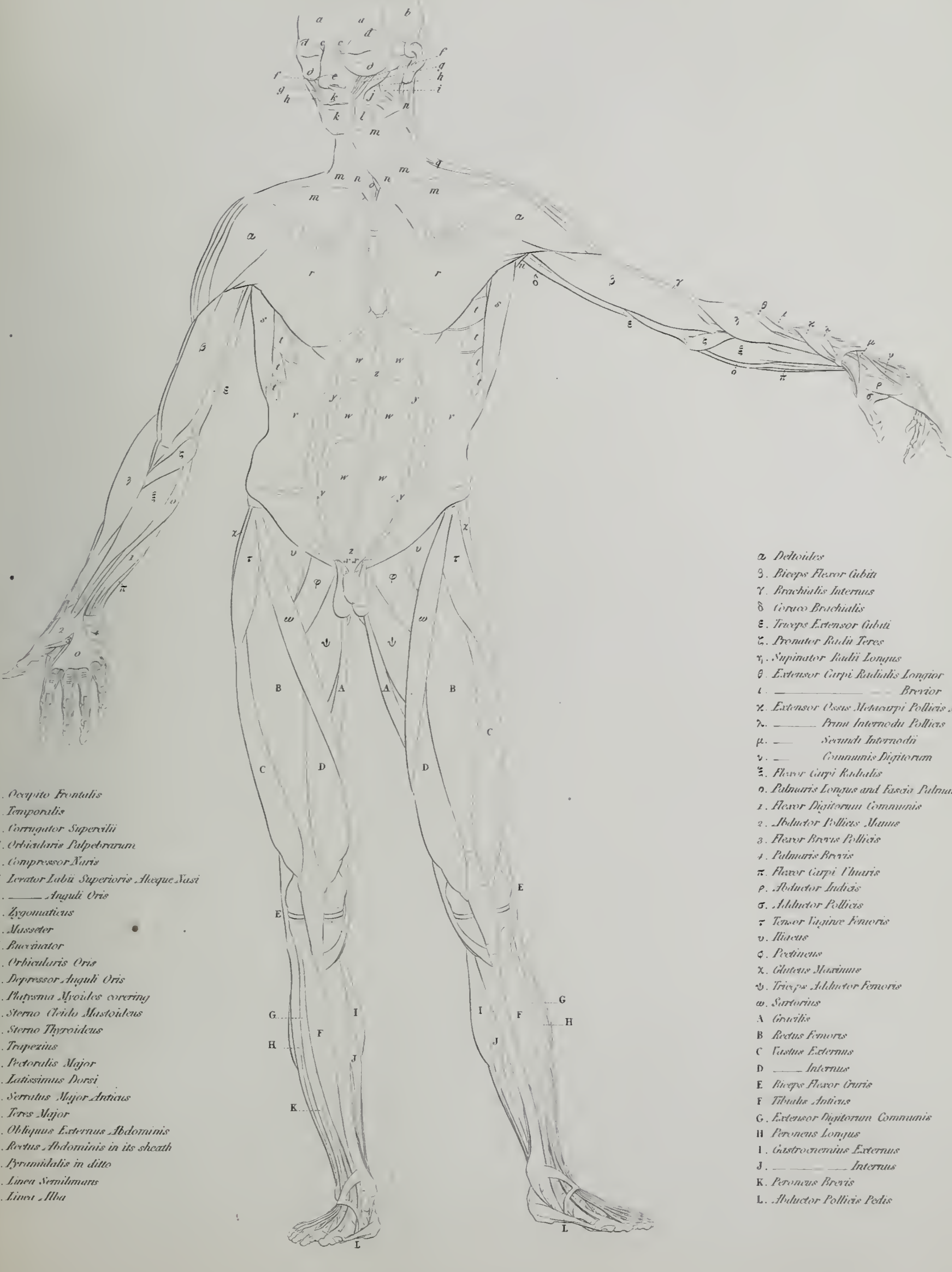
First layer of the Muscles.

Plate 3.



W. & J. W. Lowry sculp

Published as the Act directs Sept. 1. 1824, by J. Mawman, Ludgate Street.

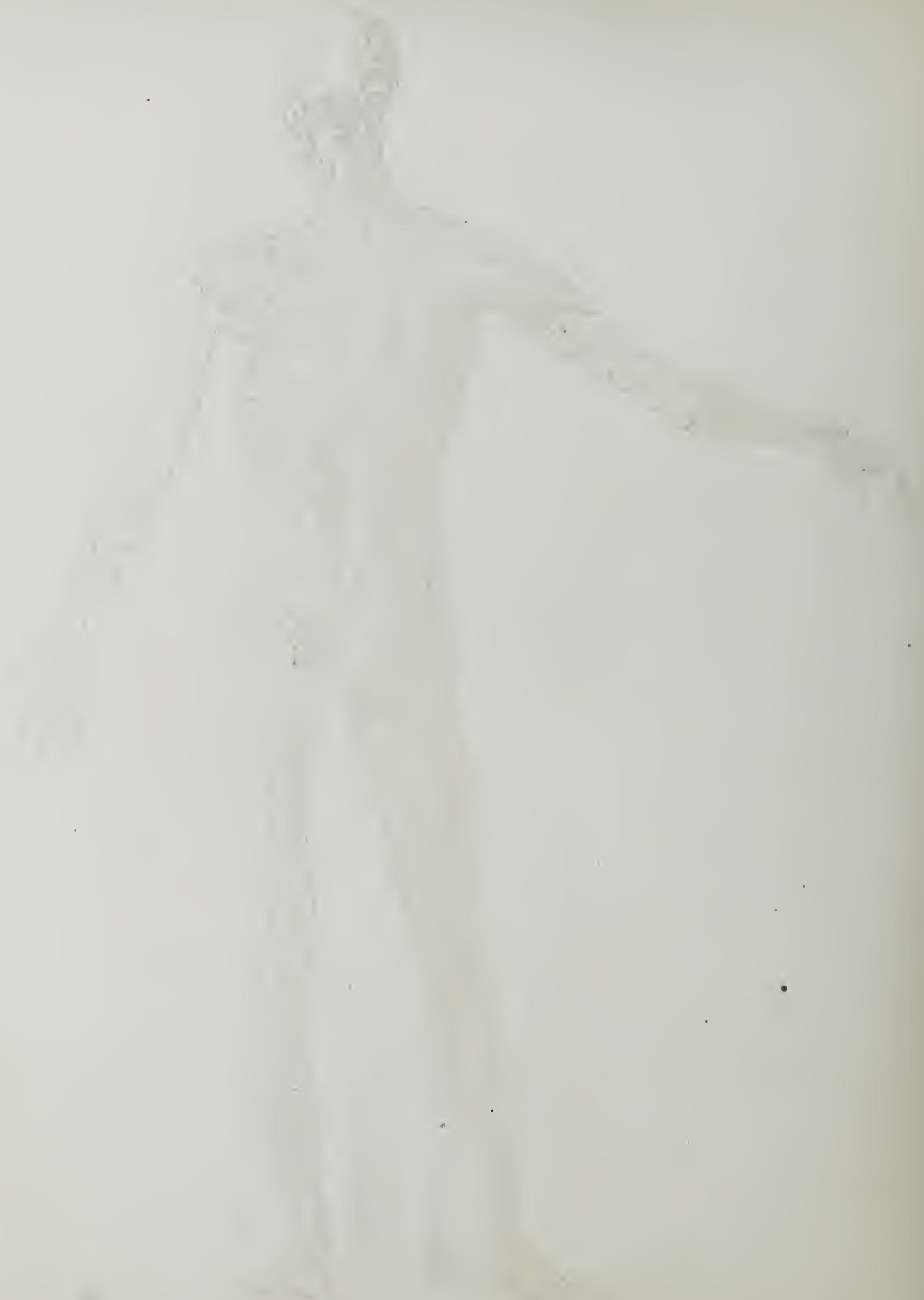


a. Occipito Frontalis
b. Temporalis
c. Corrugator Supercilii
d. Orbicularis Palpebrarum
e. Compressor Naris
f. Levator Labii Superioris Alæque Nasi
g. ——— Anguli Oris
h. Zygomaticus
i. Masseter
j. Buccinator
k. Orbicularis Oris
l. Depressor Anguli Oris
m. Platysma Myoides covering
n. Sterno Cleido Mastoideus
o. Sterno Thyroideus
q. Trapezius
r. Pectoralis Major
s. Latissimus Dorsi
t. Serratus Major Anticus
u. Teres Major
v. Obliquus Externus Abdominis
w. Rectus Abdominis in its sheath
x. Pyramidalis in ditto
y. Linea Semilunaris
z. Linea Alba

α *Deltoides*
β. *Biceps Flexor Cubiti*
γ. *Brachialis Internus*
δ *Coraco Brachialis*
ε. *Triceps Extensor Cubiti*
ζ. *Pronator Radii Teres*
η. *Supinator Radii Longus*
θ. *Extensor Carpi Radialis Longior*
ι. ——————— *Brevior*
κ. *Extensor Ossis Metacarpi Pollicis Manus*
λ. ——— *Primi Internodii Pollicis*
μ. —— *Secundi Internodii*
ν. —— *Communis Digitorum*
ξ. *Flexor Carpi Radialis*
ο. *Palmaris Longus and Fascia Palmaris*
1. *Flexor Digitorum Communis*
2. *Abductor Pollicis Manus*
3. *Flexor Brevis Pollicis*
4. *Palmaris Brevis*
π. *Flexor Carpi Ulnaris*
ρ. *Abductor Indicis*
σ. *Adductor Pollicis*
τ *Tensor Vaginæ Femoris*
υ. *Iliacus*
φ. *Pectineus*
χ. *Gluteus Maximus*
ψ. *Triceps Adductor Femoris*
ω. *Sartorius*
A *Gracilis*
B *Rectus Femoris*
C *Vastus Externus*
D ——— *Internus*
E *Biceps Flexor Cruris*
F *Tibialis Anticus*
G. *Extensor Digitorum Communis*
H *Peroneus Longus*
I. *Gastrocnemius Externus*
J. ——————— *Internus*
K. *Peroneus Brevis*
L. *Abductor Pollicis Pedis*

Published as the Act directs. April 1. 1824. by J. Mawman Ludgate Str.t

Lowry. sculp.t



ANATOMY

Posterior view of the first & second layer of the Muscles.

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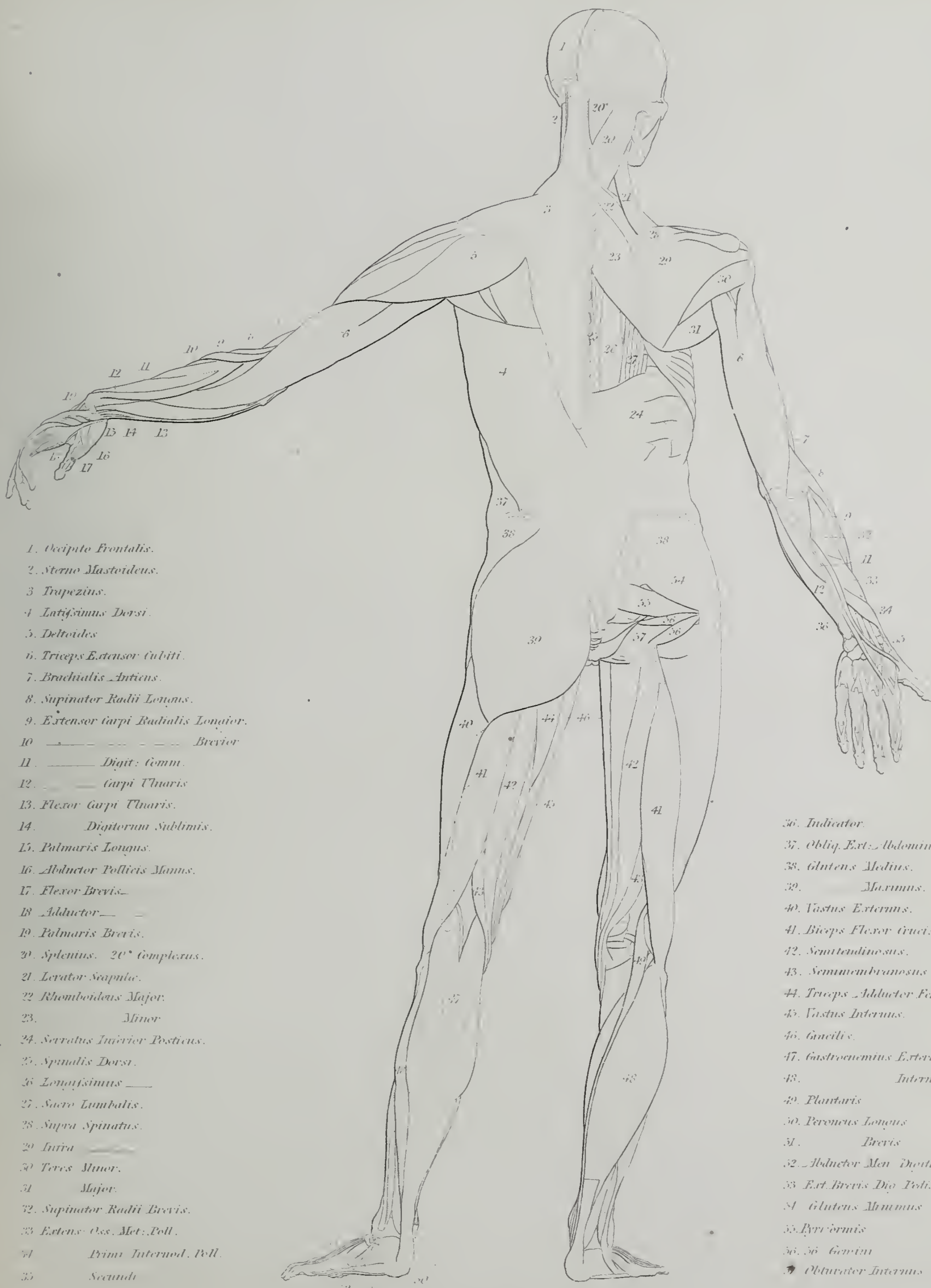
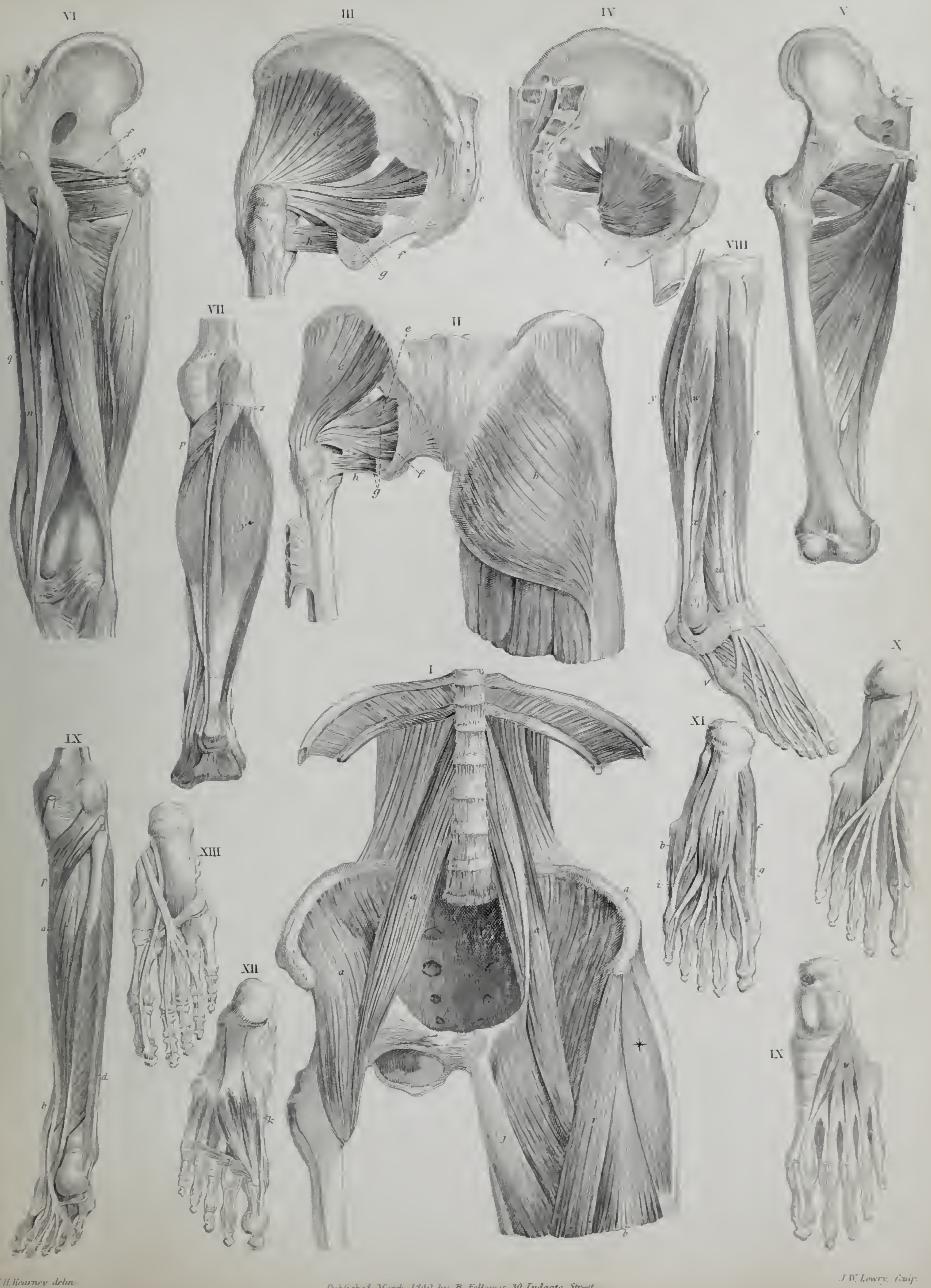


1. Occipito Frontalis.
2. Sterno Mastoideus.
3. Trapezius.
4. Latissimus Dorsi.
5. Deltoides.
6. Triceps Extensor Cubiti.
7. Brachialis Anticus.
8. Supinator Radii Longus.
9. Extensor Carpi Radialis Longior.
10. ——— ——— Brevior.
11. ——— Digit: Comm.
12. ——— Carpi Ulnaris.
13. Flexor Carpi Ulnaris.
14. ——— Digitorum Sublimis.
15. Palmaris Longus.
16. Abductor Pollicis Manus.
17. Flexor Brevis ——
18. Adductor —— ——
19. Palmaris Brevis.
20. Splenius. 20* Complexus.
21. Levator Scapulæ.
22. Rhomboideus Major.
23. ——— Minor.
24. Serratus Inferior Posticus.
25. Spinalis Dorsi.
26. Longissimus ——
27. Sacro Lumbalis.
28. Supra Spinatus.
29. Infra ——
30. Teres Minor.
31. ——— Major.
32. Supinator Radii Brevis.
33. Extens: Oss. Met: Poll.
34. ——— Primi Internod. Poll.
35. ——— Secundi.

36. Indicator.
37. Obliq. Ext: Abdominis.
38. Gluteus Medius.
39. ——— Maximus.
40. Vastus Externus.
41. Biceps Flexor Cruris.
42. Semitendinosus.
43. Semimembranosus.
44. Triceps Adductor Femoris.
45. Vastus Internus.
46. Gracilis.
47. Gastrocnemius Externus.
48. ——— Internus.
49. Plantaris.
50. Peroneus Longus.
51. ——— Brevis.
52. Abductor Min: Digiti.
53. Ext. Brevis Dig. Pedis.
54. Gluteus Minimus.
55. Pyriformis.
56. 56. Gemini.
57. Obturator Internus.

Published as the Act directs Feb. 1. 1815, by Baldwin & Cradock, Paternoster Row.

ANATOMY.



W.H. Kearney delin.

Published March 1840 by B. Fellowes, 39 Ludgate Street.

J.W. Lowry, Sculp.

W. H. Kearney delin.

Published March 1840 by B. Fellowes, 39 Ludgate Street.

J. W. Lowry sculp.

W.H. Kearney del.

Published March, 1840 by B. Fellowes, 39 Ludgate Street.

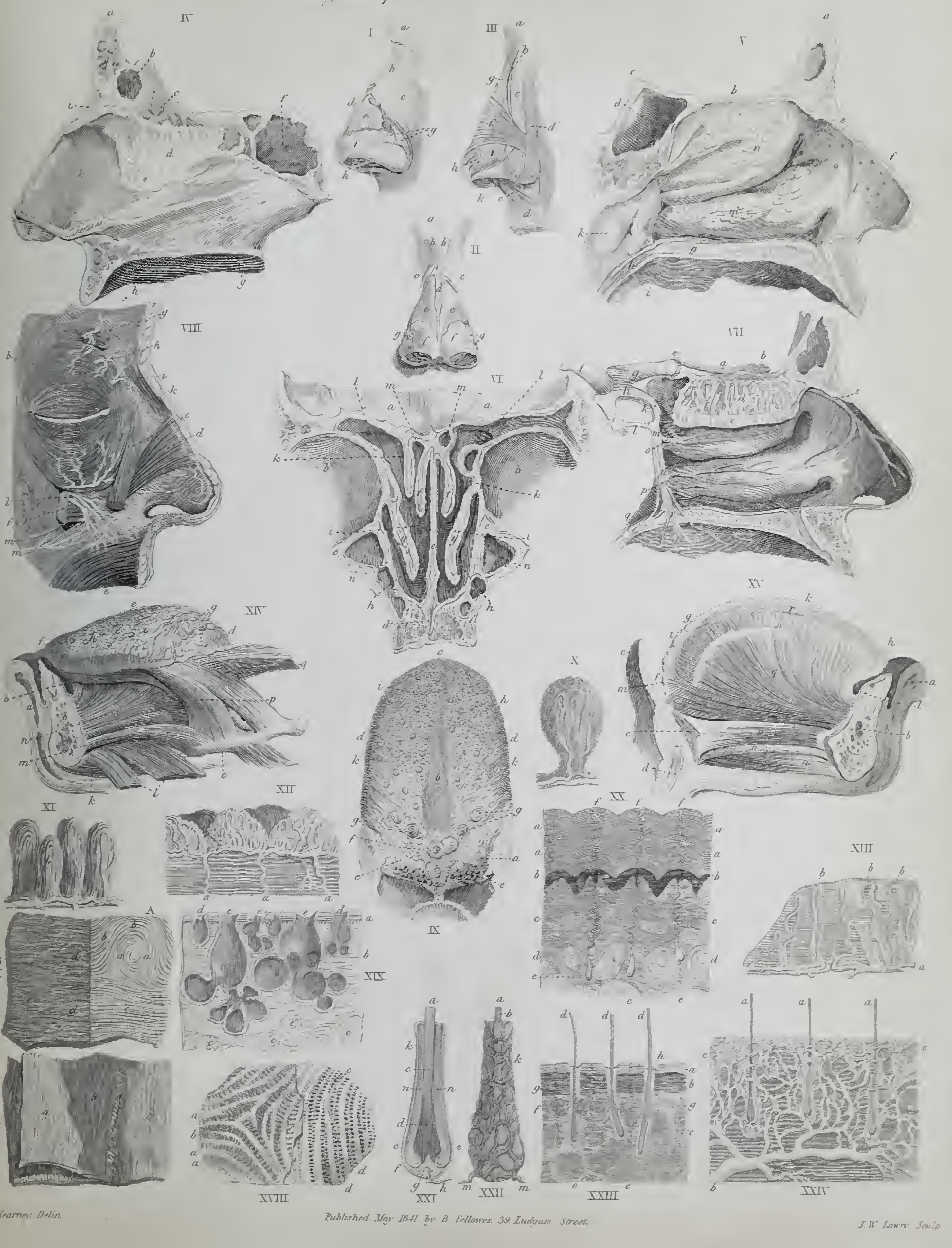
ANATOMY.

Organs of Vision & Hearing.

W. H. Kearney, Delin. Published May 1841 by B. Fellowes, 39 Ludgate Street. J. W. Lowry Sculp.

ANATOMY.

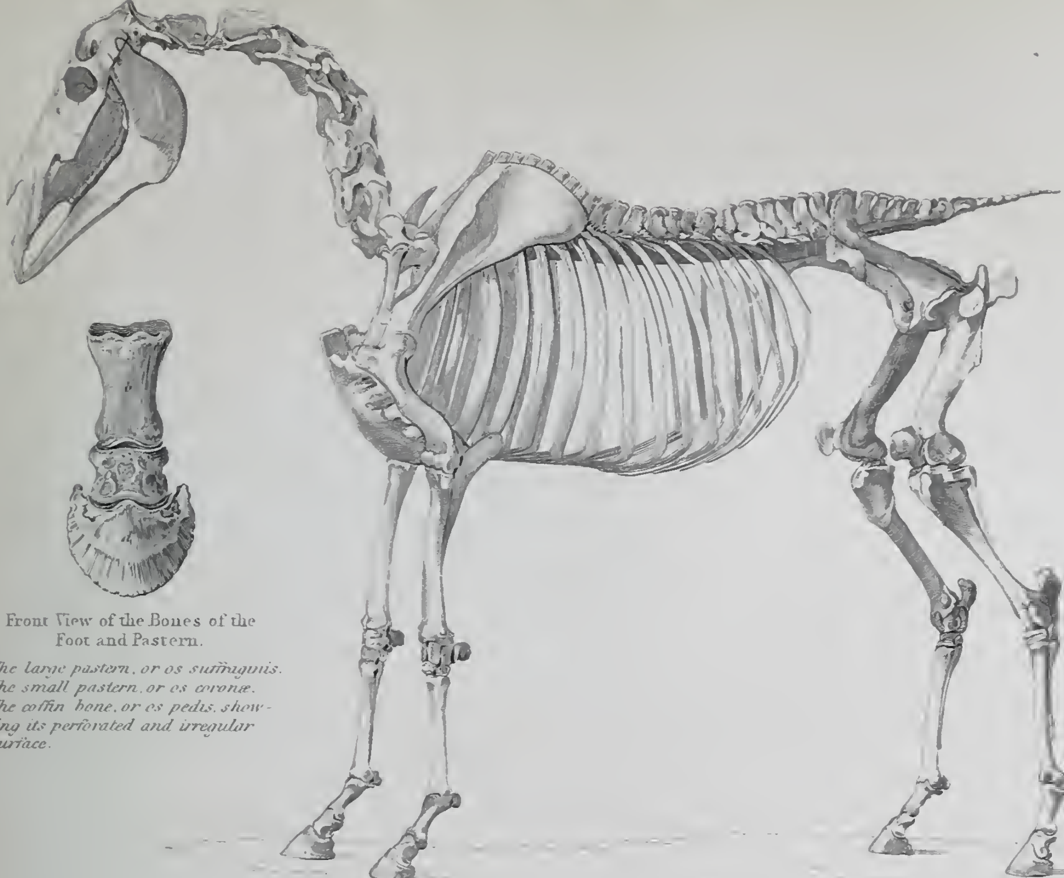
Organs of Smell, Taste & Touch.



W. H. Kearney. Delin.

Published May 1841 by B. Fellowes. 39. Ludgate Street.

J. W. Lowry Sculp.



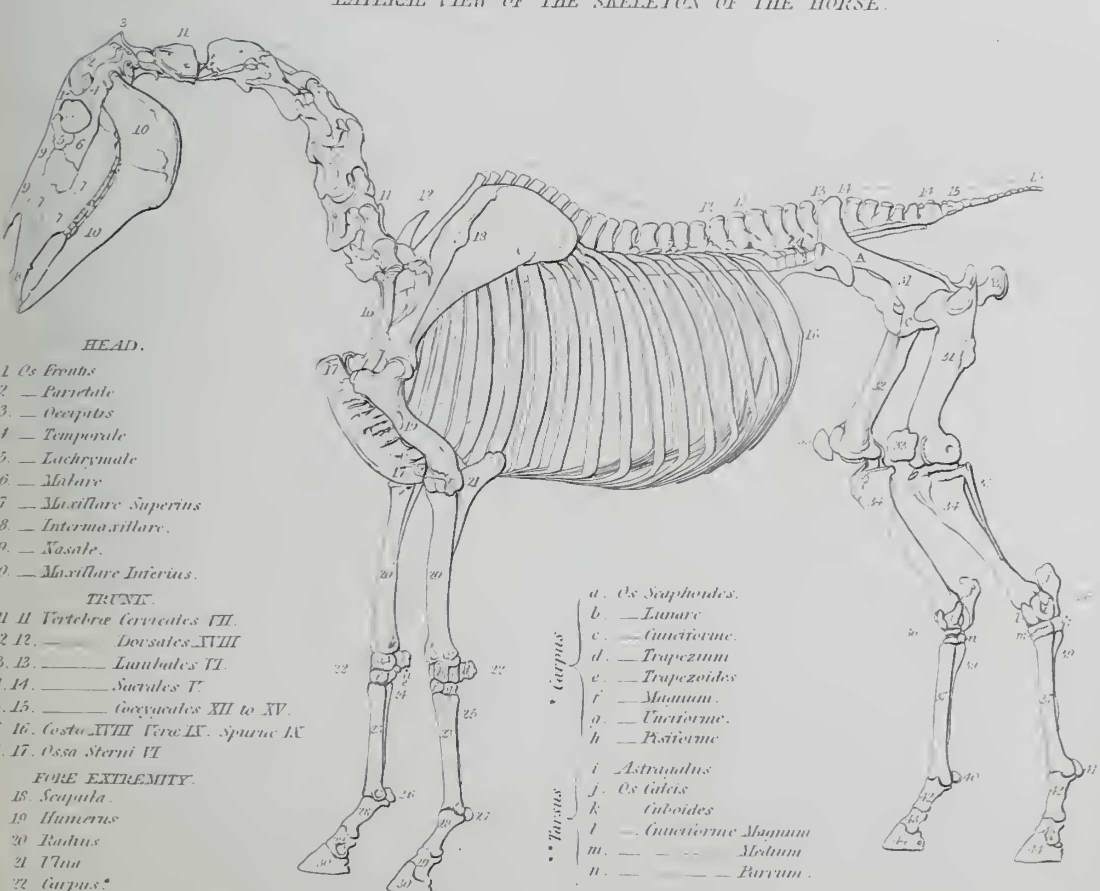
Front View of the Bones of the Foot and Pastern.

b The large pastern, or os suffraginis.
c. The small pastern, or os coronæ.
d. The coffin bone, or os pedis, showing its perforated and irregular surface.

Back View of the Bones of the Foot and Pastern.

a a The sesamoid bones.
b The large pastern.
c The small D°
d The coffin bone showing its lower surface with the holes for the passage of the arteries to the centre of the bone.
e The navicular bone.

LATERAL VIEW OF THE SKELETON OF THE HORSE.



HEAD.

1 Os Frontis
2 — Parietale
3. — Occipitis
4 — Temporale
5. — Lachrymale
6. — Malare
7 — Maxillare Superius
8. — Intermaxillare.
9. — Nasale.
10. — Maxillare Inferius.

TRUNK.

11 11 Vertebræ Cervicales VII.
12 12. — Dorsales XVIII
13. 13. ——— Lumbales VI.
14. 14. ——— Sacrales V.
15. 15. ——— Coccygeales XII to XV.
16 16. Costæ XVIII Veræ IX. Spuriæ IX
17. 17. Ossa Sterni VI

FORE EXTREMITY.

18. Scapula.
19 Humerus
20 Radius
21 Ulna
22 Carpus.*
23 Os Metacarpi magnum
24 ——— internum.
25 ——— externum

* Carpus
a. Os Scaphoides.
b. — Lunare
c. — Cuneiforme.
d. — Trapezium
e. — Trapezoides
f — Magnum.
g. — Unciforme.
h — Pisiforme

** Tarsus
i Astragalus
j. Os Calcis
k Cuboides
l — Cuneiforme Magnum
m. — — — Medium
n. — — — — Parvum.

FORE EXTREMITY continued

26. Os Sessamoideum internum
27 —— externum
28. Os Suffraginis.
29. — Coronæ
30 Pedis The Os Naviculare is placed behind the joint of the last two bones and cannot therefore be seen

HIND EXTREMITY

31 Pelvis
A. Ilium B Ischium C Pubis
32 Os Femoris
33 Patella
34 Tibia
35 Fibula
36 Tarsus**
37 Metatarsi magnum
38 internum
39 —— externum
40 Os Sessamoideum internum
41 externum
42 Os Suffraginis
43. — Coronæ
44. Pedis Os Naviculare as in fore feet

Published February 1845 by E. Fellowes 39 Ludgate Street London

Fig. 1.

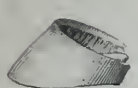


Fig. 2.

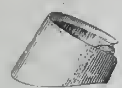
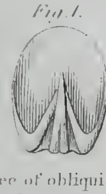


Fig. 3.

Fig. 4.



1. A foot with a proper degree of obliquity.
2. —— too upright, & its heels much too high
3. —— with low heels, crust too oblique, and wrinkled hoofs.
4. A narrow mule's shape foot.

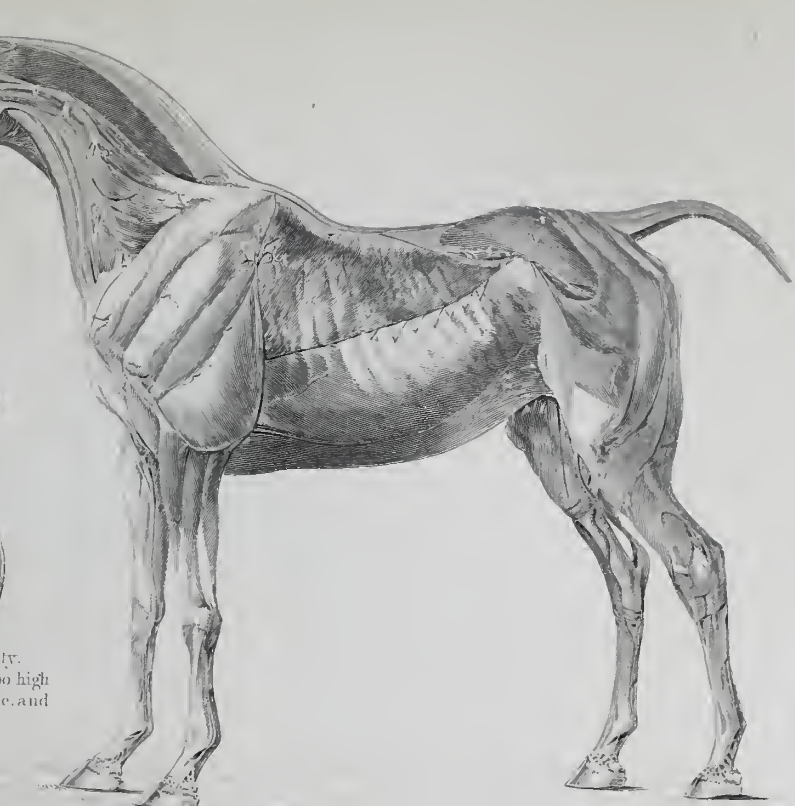


Fig. 5

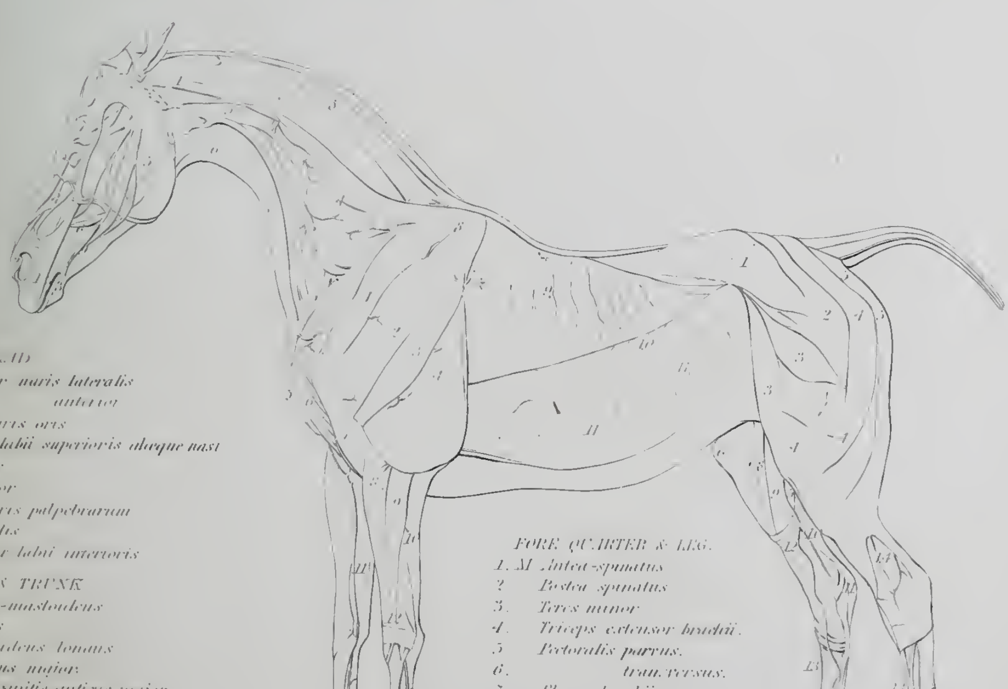
A healthy Foot in an unpared state

a a The frog
b b —— bars
c c c —— sole
d d —— seat of corns

Fig. 6

A contracted Foot

FIRST LAYER OF MUSCLES OF THE HORSE.



HEAD

1 M *Dilatator naris lateralis*
2 *anterior*
3 *Orbicularis oris*
4 *Levator labii superioris alaeque nasi*
5 *Masseter*
6 *Buccinator*
7 *Orbicularis palpebrarum*
8 *Temporalis*
9 *Depressor labii inferioris*

NECK & TRUNK

1 M *Trachelo-mastoideus*
2 *Splenius*
3 *Rhomboideus longus*
4 *Complexus major.*
5 *Rectus capitis anticus major.*
6 *Sterno thyro-hyoideus*
7 *Sterno maxillaris*
8 *Trapezius*
9 *Latissimus dorsi*
10 *Intercostales Externi*
11 *Obliquus externus abdominis.*

FORE QUARTER & LEG.

1. M *Antea-spinatus*
2 *Postea spinatus*
3. *Teres minor*
4. *Triceps extensor brachii.*
5 *Pectoralis parvus.*
6. *transversus.*
7. *Flexor brachii.*
8. *Extensor metacarpi magnus.*
9. *pedis*
10 *Flexor metacarpi externus.*
11. *internus.*
12. *Extensor suffraginis*

HIND QUARTER & LEG

1 M *Gluteus maximus*
2 *externus*
3. *Tensor vaginae.*
4 *Biceps Abductor*
5 *Semitendinosus*
6 *Rectus*
7 *Vastus internus*
8 *Sartorius*
9. *Gracilis.*
10 *Gastrocnemius internus*
11. *Plantaris*
12. *Flexor metatarsi*
13. *Extensor pedis*
14 *Flexor pedis*

In this view the Panniculus carnosus & the Levator Humeri have been removed

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